SCIENTIFIC AMERICAN

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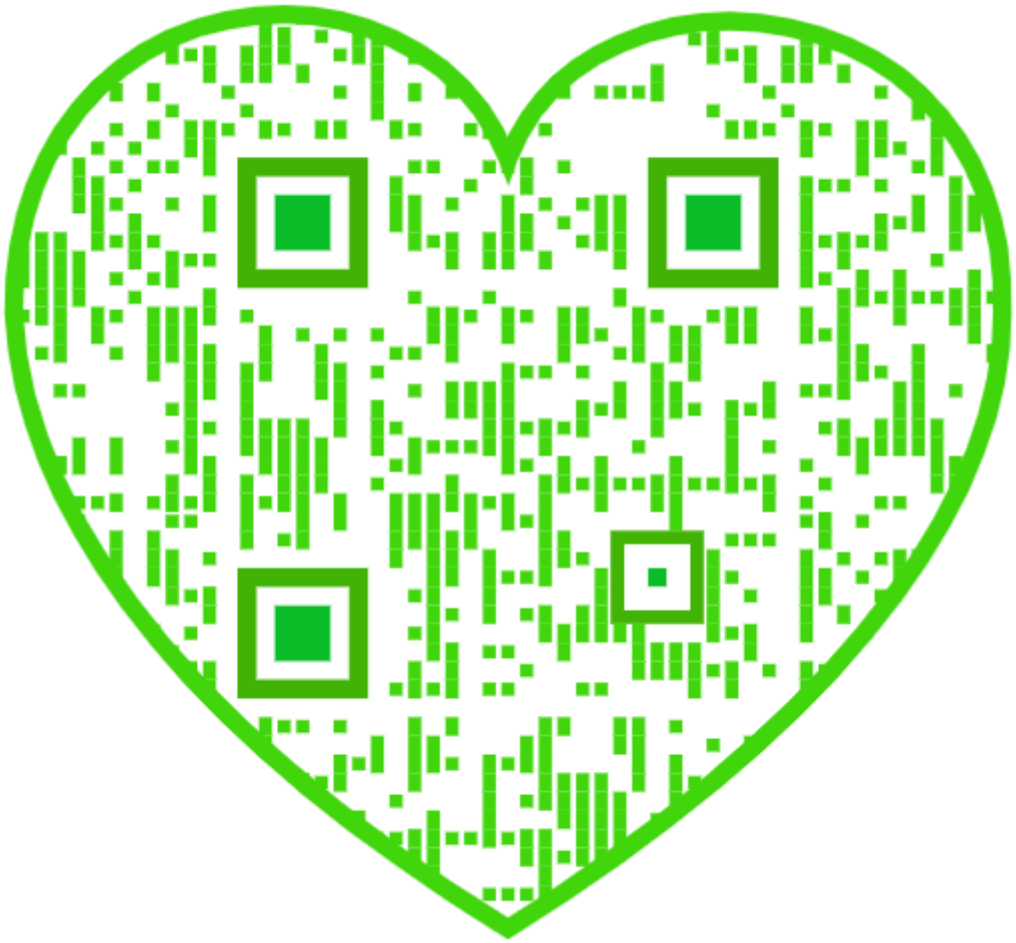

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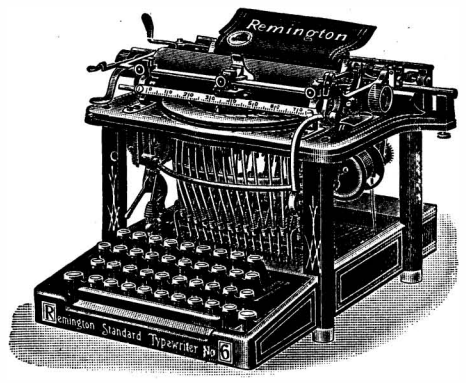

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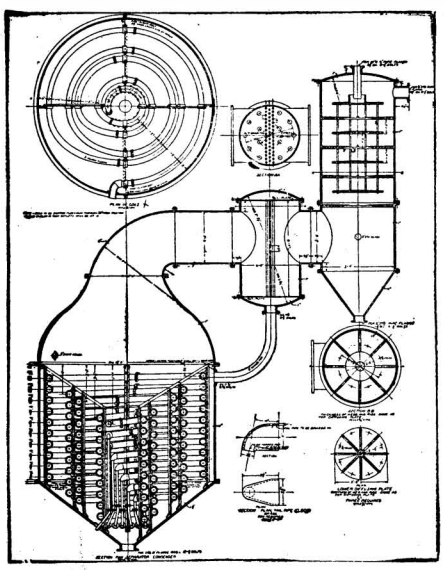

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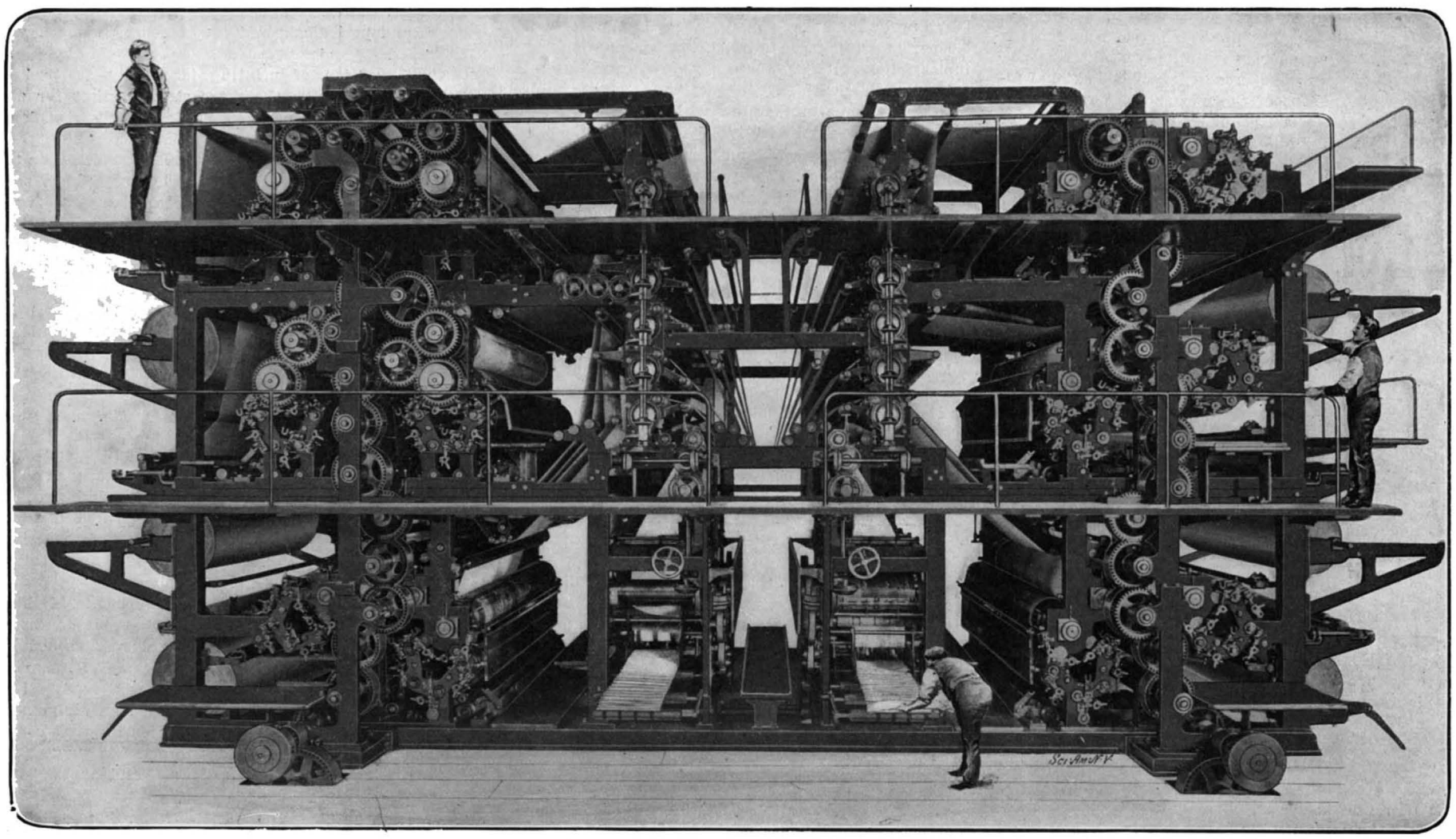

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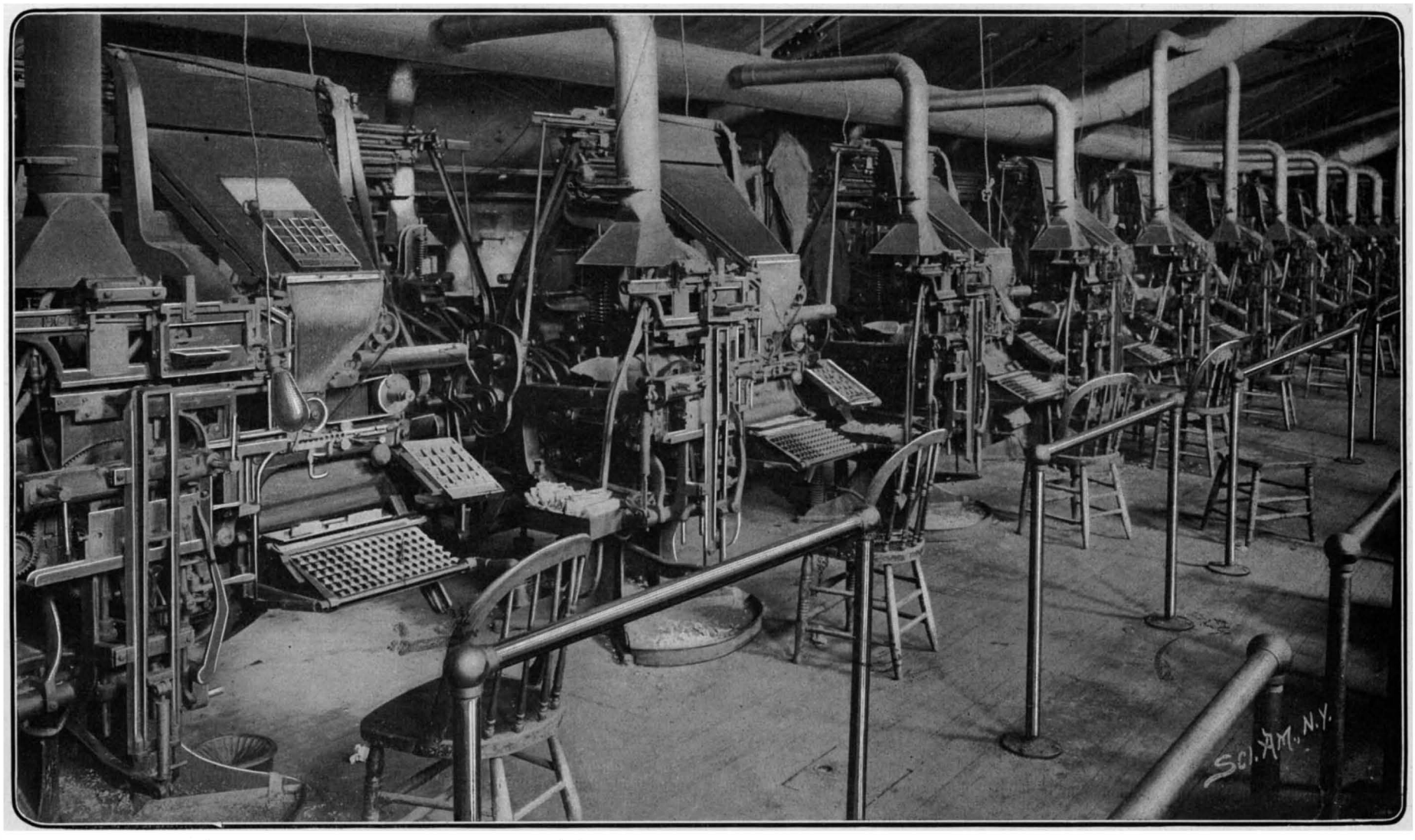

BATTERY OF FIFTY-SEVEN LINOTYPE MACHINES.

Average product, 4,000 letters the width of the letter "m" per hour. Each machine spaces or justifies the line and delivers a cast slug.

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MODERN PRINTING METHODS.

THE ECONOMIC SIDE OF THE INDUSTRY.

THE development of the "art preservative of all arts" has been very rapid during the last decade, and many of the changes have been revolutionary, resulting in enormously increased product, manufactured in quicker time and at a much lower cost. The quality of the work has also improved. The far more general dissemination of intelligence, the rapid and efficient means of intercommunication between all parts of the world, with the cheapening and broadening of educational facilities, constitute one of the most notable features in the progress of the world during the past fifty years; and the one most vitally contributing to all our great industries is the printing press. Some idea of the volume of business may be gained when it is stated that in 1900, the census year, the value of the finished product was $347,055,050. This sum was almost equally divided between newspapers on the one hand and book and job printing on the other. In the United States there are 22,312 establishments, 15,305 of which publish or print newspapers. The total capital invested is $292,517,072. A large clerical force is necessary to transact this amount of business; 37,799 salaried officials, clerks, etc., draw $36,090,719 in salaries, while the actual work is done by 162,992 persons, drawing $84,249,954 in wages. Miscellaneous expenses of these establishments were $55,897,529, and the cost of materials used was $86,856,990.

Of the total value of products, advertising forms 43 per cent, subscriptions and sales 35.8 per cent, and book and job printing, including miscellaneous products, 21.2 per cent. The total circulation of daily papers is enough to supply one for every five inhabitants, and the total circulation per issue of weeklies and monthlies is one to each two inhabitants. Ninety-four per cent of all the publications are printed in the English language. One and a quarter billion pounds of paper were used in the census year. Of this amount 77.6 per cent was consumed for newspapers and 16.4 per cent for books and periodicals, and only 6 per cent for job printing. On analyzing the total circulation of each State it is found that the ten leading States supply four-fifths of the circulation per issue of all publications, thus indicating the concentration of circulation in certain populous States. Weekly publications are more numerous in proportion to the inhabitants in the West and Northwest. New England ranks high in dailies but low in circulation, suggesting that in that densely settled region the daily has to some extent supplanted the weekly.

There were 18,226 publications reported to the census authorities, while 3,046 publications failed to report. This would give a remarkable total of 21,272 periodicals, and the aggregate circulation of those reporting was 114,229,334 per issue, while the aggregate number of copies issued during the census year was 8,168,148,749.

The average capital of those engaged in the printing business is $12,574; the average value of their products is $14,569. These figures compared with those of a previous decade show that in a period of ten years an increased capital is required to produce the same or even a smaller value of products; this is largely caused by an increase in wages and a decrease in working hours. In 1850 a compositor in New York received $9 per week; ordinary job compositors now receive $19.50 per week, and operators on machines from $24 to $27, depending on the time of day or night they take their shift. In the opinion of many large operators, the number of wage earners has actually increased rather than diminished. The introduction of machine composition has been of decided benefit to the employe, offering a new field for endeavor. There are few unemployed men in the printing trade, as is shown by the fact that when in 1900 the Typographical Union was called upon to supply 150 men for a special job of city printing, only 100 could be obtained, and these with difficulty.

A classified list of periodicals is given below, showing how the list is divided:

Period of issue:

Daily	2,226
Triweekly	62
Semiweekly	637
Weekly	12,979
Monthly	1,817
Quarterly	237
All other classes	268
Total	18,226

Character of publication:

News, politics, and family reading	14,867
Religion	952
Agriculture, horticulture, dairying, and stock raising	307
Commerce, finance, insurance, railroads, and trade	710
General literature, including magazines	239
Medicine and surgery	111
Law	62
Science and mechanics	66
Fraternal organizations	200
Education and history	259
Society, art, music, and fashion	88
Miscellaneous	365

The average number of inhabitants to each publication is 4,170. News, politics, and family reading form the bulk of all publications, 81.6 per cent being taken up by them; religious periodicals come next with 5.2 per cent; finance, railroad, insurance, and kindred topics follow with 3.9 per cent; agriculture and allied subjects follow with 1.7 per cent; and the other subjects while most important, follow with very small percentages, which can practically be neglected, as none of them exceeds 2 per cent, and most of them come nearer 1 per cent or below. The publications devoted to specialties have been steadily superseded by the large dailies, which have invaded every field of journalism. The Sunday edition has become a most important factor in journalism, which when aided by the linotype or other composing machines have done the work of four to nine men. The line cut and the tint cut, called "half-tone," have made the rapid production of a counterfeit presentment of a photograph possible.

Mechanical composition put an entirely new aspect on affairs. The New York Herald, for example, has no less than fifty-six linotype machines, doing the work of hundreds of compositors in far less time and with a new dress of type each time. The daily press has seized with avidity on these improvements, and has thus worked a revolution in the printing trade, causing a vast increase in the number of printed pages, and instead of 24 pages in 1890, we have occasionally 120 pages of a Sunday in 1903, the departments and supplements being well segregated. The reading matter now presented in even one metropolitan newspaper is not only satisfying to the reader, but in amount is often far beyond his capacity to assimilate. We get all this for five cents, which reflects credit on the management and the "city" and "Sunday" editors of our great dailies. Such excellent news-gathering and presentation is not, however, limited to New York; even Seattle, in far-away Washington, does practically the same thing on a reduced scale.

Out of the 18,226 publications, 2,226 are dailies, with a circulation of 15,102,156; 62 are tri-weekly, with a circulation of 228,610; 637 are semi-weekly, with a circulation of 2,832,868; 12,979 papers are issued weekly, with a circulation of 39,852,052; there are 1,817 monthly publications, whose circulation is 39,519,897. The quarterly publications are mostly devoted to special subjects, and only number 237, but their circulation is very respectable, as they issue 11,217,422 per issue. Semi-monthly, semi-annual and yearly publications number 268, and have a circulation of 5,541,329. Out of 18,226 publications, 17,194 were printed in English.

The production of monthlies is centralized in a few States, ten producing 92.5 per cent of the aggregate circulation. The circulation of periodicals is not governed by local consumption, but is distributed regardless of State lines. The whole question of newspapers is admirably discussed in the Census Bulletin No. 216, by Mr. W. S. Rossiter, and we are largely indebted to it.

In 1900, cities of 201,000 inhabitants and over contained 79 per cent of the separate job-printing establishments of the country, and 97.7 per cent of the total job product emanated from them.

QUANTITY AND COST OF PAPER USED.

Our figures show the quantity and cost of paper used and the average cost per pound, in 1900.

Kinds.	Pounds.	Cost.	Average cost per pound. Cents.
News	956,335,921	$22,197,060	2.3
Book and periodical	202,296,263	9,356,490	4.6
Job printing	74,510,064	6,270,306	8.4
Total	1,233,142,248	$37,823,856	3.1

In this table is presented a division of the paper used in 1900, according to the several classes of products which, combined, produced the total value of products of newspaper and periodical establishments. About one and a quarter billions of pounds were used during the census year. This large quantity was utilized in the following proportions:

	Per cent.
News	77.6
Book and periodical	16.4
Job printing	6.0

It is important, however, to observe that these proportions in weight do not by any means hold good in cost. The latter shows the following proportions:

	Per cent.
News	58.7
Book and periodical	24.7
Job printing	16.6

It is clear that while the quantity of paper used for newspapers far exceeds that consumed in the other branches of the industry, it is proportionately much less expensive.

The average cost per pound shown adds confirmation to deductions drawn that the cost of materials for book and job work was over 40 per cent greater than that for newspapers and periodicals. If the item of paper alone were considered, this per cent would be increased. The average cost per pound of paper consumed by newspapers and periodicals combined was 2.3 cents. The average cost per pound of paper for books and periodicals and job printing combined was 5.6 cents.

The invention of printing is usually ascribed to Gutenberg, although there are strong claims for others. But the consensus of opinion of close students of typography is almost unanimous in giving him credit for the improvement over block printing by the introduction of movable types. The subject has been discussed *pro* and *con*, scores of books have been written on the subject, but still Gutenberg remains as the sole figure around which the typographic art centralizes and is crystallized into concrete and usable form. We may depart from his idea, we may assemble matrices instead of individual types, but the principles involved are the same. His press was of the crudest description, yet almost perfect work was produced on it—work which makes even the millionaire-collector sigh to possess.

HOW A NEWSPAPER IS PRODUCED.*

Nowhere in the world is the value of time so thoroughly appreciated as in the modern newspaper office. There every minute counts, and if everything isn't done on the scheduled minute there are a hundred thousand or more readers asking why, and there is a managing editor and a publisher ready to make things interesting for those who are to blame.

There is no harum-scarum rush and bustle. Behind the noise and scurrying and the apparent confusion there is a system and a mass of rules and schedules as inviolable as the laws of the Medes and Persians.

The city editor has an assistant who reads all of the newspapers, and in a diary, called an assignment book, makes a memorandum, and when the time comes the reporter is given the story to get. So suggestions as to what may happen are noted, and as the time comes the event is covered. Each reporter who leaves the office has something definite to do. Everything is foreseen.

The day's work began, as was the case with the Pope's death, perhaps years before. But the real work of the twenty-four hours begins at 3:15 A. M., when the city edition of the paper is placed on the managing editor's desk, followed a few minutes later by the other papers. Everybody else has gone home in the editorial end except a reporter and a telegraph editor. In the composing-room and the stereotyping-room are a few men in reserve for extras. In the basement the huge presses are grinding out the paper and a score of delivery wagons and a hundred men are distributing the paper after a night spent in preparation for this final hour.

Then the managing editor is reading the morning papers. He dictates to a stenographer suggestions for covering the news of the dawning day, incidentally criticising the work of the past day as shown in the newspaper before him by comparison with its rivals. He really makes news, for he suggests stories that otherwise might not be gotten. Telegrams are sent to correspondents telling them what to do with impending news. Orders are given for pictures. But all of this is tentative. The managing editor is working as if nothing unforeseen would happen. Twenty hours later something may happen that may spoil all his plans. His instructions given, the managing editor goes home at 4:30 A. M., or later, while the presses are still running off the city edition.

At 9 A. M. the work of the local department begins. An assistant to the city editor comes on duty and begins his day's work of reading the city papers. His duty is chiefly to get tips for assignments for the reporters. The day city editor arrives at 11 A. M. He maps out the day's work of the reporters and the photographers in accordance with the news in sight and instructions from the managing editor and city editor the night before.

Each newspaper must have its own story of anything of any consequence. Each has a certain individuality of its own and a style of treatment which gives each newspaper a following just as each breakfast food has its devotees. The assistant city editor goes ahead as if there were no city editor, deciding things as they happen. This style is followed throughout the office, and every man thus has his share of responsibility. A certain number of pictures are need-

* Abstract of article by William M. Handy, Sunday editor of the Chicago Tribune, in Mahin's Magazine.

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ed to illustrate the paper. The assistant city editor and the managing editor's secretary go ahead and arrange for these as if nothing else were to happen, and when the artists arrive at 2 P. M. they set about making them, though most of them may be crowded out at 10 P. M., when better pictures may be in sight. Each day sees probably twice as much matter prepared as is needed.

The city editor arrives at 4 P. M. and the managing editor a little later. These men read the morning papers before they went to bed. When they got up the 3 o'clock editions of the evening papers were on their breakfast tables, and even before breakfast they had telephoned the office to learn the news of the day and consult with the assistants, thus actually beginning work as soon as they are out of bed.

On the managing editor's arrival at the office he finds on his desk a summary of the day's news prepared by his secretary, while the day report of the Associated Press is at hand for reference, and as a pile of wheat from which grains missed by the afternoon papers may be winnowed and ideas may be gleaned for stories of importance. The city editor having the local news of the day at his fingers' ends comes in to consult with the managing editor. In the meantime the editorial writers and other department men have turned in their copy.

At 6 P. M. the advertising manager tells the managing editor how many columns of advertisements he has for the next day. The night editor arrives a few moments later and then the probable size of the paper is determined—whether twelve, fourteen or sixteen pages, in accordance with the aggregate number of columns of advertising and reading matter.

At 6:30 the telegraph editor and his assistants have arrived. The city editor and the telegraph editor then prepare separate schedules of their news, the amount of space in each being expressed in decimals. These first schedules are tentative, to be succeeded by revised figures a few hours later which must be adhered to except for important reasons.

The routine copy has, in the meantime, been given to the night foreman of the composing-room, who cuts it into "takes" for the linotype operators, who begin work at 7 P. M. The separate takes into which each story is divided are numbered, and they are also given letter or class numbers, that all matter of a general character may be assembled together on the galleys. As the matter is set, proofs are taken and sent to the proofreaders for correction of typographical and other obvious errors. After correction they go to the make-up table ready to be put in the forms.

Meantime, upon a large sheet of paper, the night editor has copied the schedules of the city editor and telegraph editor and, having added the totals, he summarizes these in another column.

The copy readers in the telegraph and local room are working in accordance with the schedules. Each piece of news is made to fit the space assigned to it. Any new story means the omission of another or the trimming of several, for only 112 columns can get in sixteen pages—no more, no less.

When the managing editor arrives from his dinner at 9:30 o'clock, the city and night editors come into his office. He goes over the schedules and asks about each piece of news. His judgment is that nothing in particular has happened; fourteen pages are enough. "We are printing too many long-winded stories, anyhow," he says; "kill some of this 'cheese' and have a bright, snappy paper."

The night editor makes out a schedule for each page after the managing editor has determined what stories shall go on the first page.

The last form for the first edition goes to press at 12:30. By 1:10 A. M. it has been stereotyped, the plates are on the press and the mailing-room is getting the first papers.

The mailing-room has been preparing for this moment. Twenty wagons are waiting to carry the papers to the early morning mail trains. The papers are wrapped in bundles for dealers and routed so as to simplify the work of the mail clerks. The wagons dash to the stations, and soon papers are on their way to the country.

Then comes the work of getting out the city edition. The mail edition is made for country readers. It contains all the general news covered in much better shape than the dailies in the small cities could, but it also has agricultural news and accounts of events happening in the Northwest of no importance to the people of the city. Politics has been given a more prominent consideration than is necessary in the city edition. When the night editor gets copies of the first edition he goes over the paper and "kills" news of no interest to city readers and trims other items that are worth a smaller mention in the second edition. The whole paper is revised with the city reader in view. The telegraph and city editors report their new stories and news in the paper is cut or trimmed accordingly. Stories of purely local interest are given more prominence and some crowded out of the mail edition are restored.

The city edition goes to press at 2:30 A. M. and is being printed by 3:15. The wagons that carried the papers to the railway stations now receive bundles for delivery to newsdealers and carriers and the morning paper is ready for the reader.

Practically two separate newspapers have been issued—one for country and one for city readers, each prepared with regard to the varying tastes of rural and urban readers. In the process enough matter to make two or three newspapers has been sifted and winnowed, and everything has been done on a clockwork schedule as regular as that of the railroad which bears the mail edition to thousands of readers in the smaller towns of the Northwest.

A MORNING WITH THEODORE L. DE VINNE.

Mr. Theodore L. De Vinne spends the greater part of the day in his library, surrounded by his noted collection of books on the printing art. Certainly there are few printers in the world to-day who are better qualified to talk both of the history of their craft and its practical side as well, for he has seen the birth and growth of modern printing, and is still its best chronicler. The question which first occurred to the interlocutor was, "Who invented printing?" We receive a conservative answer, which should make us all cautious on snap judgments on the origin of inventions.

"Movable types were known before Gutenberg made type, but they were cut singly. I think he was the inventor of the adjustable mold. To make a mold, on which you can clamp any matrix of any letter, was the key to the invention. There is no proof that Gutenberg made the first movable type. Koster, a Hollander, of Haarlem, is credited with making wood type. There is no certainty that he did; there is certainty that he never printed a book. The vitality of typography depends upon types cheaply made and easily combined.

"The Psalter of 1457, made by Füst and Schoeffer at Mentz, was recently sold for $27,000, although it is a thin single volume. Of the Mazarin Bible there are about fifteen known copies. How long it took to print it is pure speculation. Gutenberg began making experiments as early as 1439-40, and the earliest date that has been assigned to his Bible of forty-two lines is 1450. There is another Bible of thirty-six lines, which some think antedates the Mazarin Bible. If you examine each single letter, anyone would say we cut letters more carefully now, but the general effect of this Bible of 42 lines is admirable, and this superiority is largely due to great care in its presswork. In modern printing when you put a dry sheet of paper on a cylinder, it is swiftly carried over the face of the type. It just kisses the ink on the type, and is then swept off. The old hand pressman was told to rest on the bar for two or three seconds after impression, so as to let the ink saturate the paper. The merit of Morris's presswork is largely due to damp paper and the dwelling on the impression.

"I began my experience as a printer in 1843-44 in an office which was not as big as one floor of a small dwelling house. It had only one old-fashioned Washington hand press and no steam press. The newspapers even did not have steam presses. In 1835 I went with my father, who was an old friend of James Harper, to the latter's printing office. It was the first time I was in one. This printing house was in Cliff Street (just where they are now). It had a dozen hand presses, but no power press. One or two newspapers only had them. The New York Sun, established by Benjamin H. Day, was printed on a hand press. He was a job printer, and as he did not get enough work to do, he conceived the idea of making up a paper and selling it for a cent. The circulation ran up so rapidly he could not print enough. He engaged three pressmen, and each one worked about twenty minutes and pulled like a horse at the hand press until he was played out, and then another took his place. They got out 400 or 500 copies an hour. The Sun was afterward sold to Moses Y. Beach, who put in a cylinder press.

"There was not much objection made to the introduction of the power press here. It began in a very slow and timid way. The first attempt to improve the quality of printing was made, I think, by Daniel Fanshaw, who had an office at Ann and Nassau Streets. He put in a Tuft's press, and to furnish the power a donkey was brought every morning, and bands were passed under him by which he was hoisted to the top floor, where he trod a treadmill and furnished the power. That was about 1836 or 1837. After the Tuft press came another, the name of which I cannot recall. Then came the Adams, and this is in use to-day. A Boston book house even now does three-quarters of its work on the Adams platen press.

"I read somewhere that the papers abroad have larger circulations than our papers have; one London paper prints daily 857,000 copies. The Petit Journal, Paris, goes still higher than that, but they are papers of smaller size.

"So far as mechanical finish is concerned, type was never made so well as now. The tendency of the time seems to be, not only on the part of the publishers, but on that of the authors, to have a book set in distinctive type, something out of the ordinary run, which I think is a great mistake. Type is made to convey the thought of the author, but any publisher or any printer who attempts to make the manner superior to the matter puts the cart before the horse. I do not object to individuality or to decoration. The old masters made their decoration with engraved initial letters. The reader ought not to be led to think more of the mannerisms of printer or engraver than he does of the information conveyed by the author. For purposes of display I think the Cheltenham type is excellent. It is a slender type, yet extremely readable. You can crowd a great deal of matter in a very little space. The Cheltenham type favors one of my theories; it has very long ascenders and descenders. Take the lower case *g* and *f*; one drops down and the other stands up, and thus produces the white lane between lines of letters that helps reading.

"There is now great admiration for Caslon type, but some of it is unthinkingly bestowed. The 12-point Caslon type is a beautiful letter, but Caslon types of smaller face are very mean. The Renner type is named after the man who first made it. Publishers claim that 10-point, or long primer, is the best size of type for ordinary book work.

"Hand type setting will never entirely go out of fashion. When the linotype was introduced, I rated it as an attempt on the part of the inventor to set type without proofreaders. I have had to change that rash judgment. When a compositor found that his situation depended upon his accuracy, he became more careful. We now have men who can work on the linotype and set a whole paragraph without a single error, something that was rarely ever done in hand work. There is still a field for the machines that use foundry type. Machine type setting has come to stay. The average reader could never be supplied with the amount of reading material he receives were it not for the linotype machine. At first the compositors of this country were furious at machines that did this work, but when they found it gave them better pay, they were reconciled to the change.

"In 1872-73, book illustrations were from relief plates and were engraved on wood. Wood engraving is now practically a lost art. In about ten or fifteen years the art or craft of wood engraving will be as obsolete as that of the alchemist. Photo-engraving has taken its place, and it has undoubtedly been of immense service in a great many branches. It has many limitations. The first is that you cannot print a photo-engraving properly unless you use highly-surfaced paper, and the surfaced paper that is preferred is the so-called "coated" paper, which is nothing more than paper-fabric whitewashed. In nearly all periodicals the type work is entirely subordinated, and notwithstanding all our claims for improvement and superiority the printing of type on the average is not as well done as it was fifty years ago. For advertising purposes, for the pretty little pamphlets which are so common, photo-engraving has been a great blessing. They save the cost of engraving, and enable a man to show things that never would have been shown at all if it had not been for that art. As a rule the type work about the illustration is indistinctly printed. In the old times, when a man made a design he had to draw it of the exact size; but now he draws it on a sheet that is anywhere from four to ten times the size of the illustration. When it is reduced by a photo-engraver the middle tints, the obscure grays and the pale grays, are run together and the illustration is foggy or muddy. It has no clearness or brightness. Designers and photo-engravers, though they have been helpful to printers in some directions, have been injurious in others. In order to show the middle tints of a photo-engraved illustration, the pressman has to carry little ink and do a deal of rolling. To give engravers a fair show, publishers too often select the lightest faces of type, and the consequence is that the type looks weak and mean. There is none of the clearness and boldness that there used to be. Photo-engravers have damaged printing by compelling the too free use of coated and highly-surfaced paper. The old method of wetting paper is the true method for producing readable presswork. Mr. Morris was the first person who tried to restore printing to its primitive simplicity. I am speaking of his method of presswork. He used type with strong black faces, and he did his printing on damp paper with an elastic impression, so as to show an indentation which he would not allow to be pressed out. In my boyhood days, pressmen printed on damp paper against a woolen blanket. They dampened three or four sheets, or sometimes a quire at a time, depending upon the thickness of the paper. After it was printed it was dried on poles and taken down and put in a press, and the marks of indentation taken out. Printing is now done on dry paper, and these troublesome processes have been discarded."

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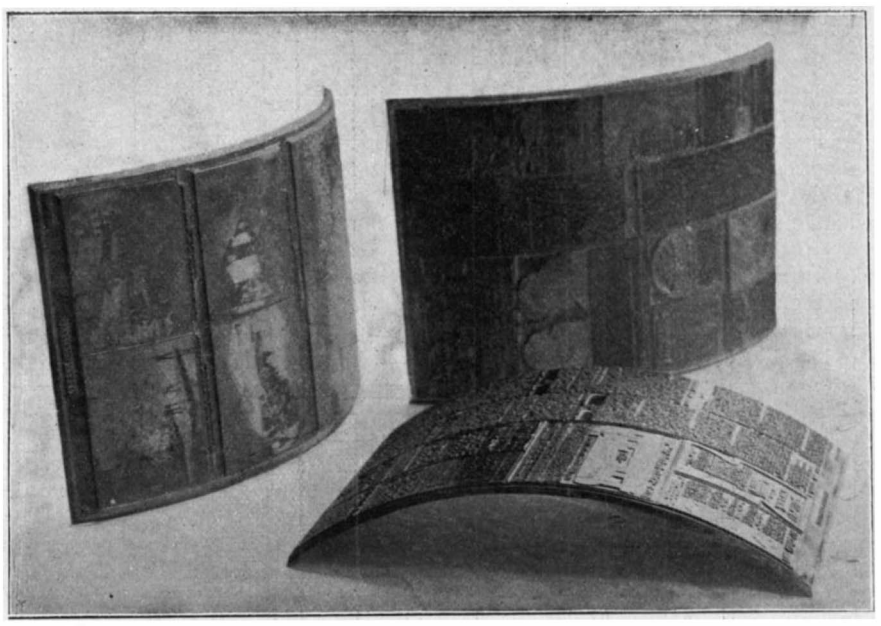
THE MANUFACTURE OF PAPER AND PAPER PULP.

Improved methods in machinery and the great change in the character of materials used has had an important bearing upon the printing art. In the earliest mills established in this country, the raw fiber, after being prepared in the beating machine, was formed into a sheet in a mold or wire sieve which was dipped from the pulp vat by hand, the water drained off and the pulp left in a wet sheet in the mold. The sheets so made were turned out upon a felt press and then dried by exposing to the air in single sheets. Such mills were small and the output was limited. Strictly hand-made paper to-day is a rarity, although it exists. By the aid of the Fourdrinier machine the transformation of the fluid to stock or finished paper is made an automatic operation. The pulp is screened from the vat over an apron to a moving endless wire cloth made of closely woven fine brass wire, and supported by a series of small metal rolls set close together, yet without touching each other. In this way an even surface of the wire cloth is maintained; and by preserving an unvarying flow of the pulp and a constant forward motion of the wire cloth, the thickness of the layer of pulp deposited was kept uniform. By lateral motion of the supporting



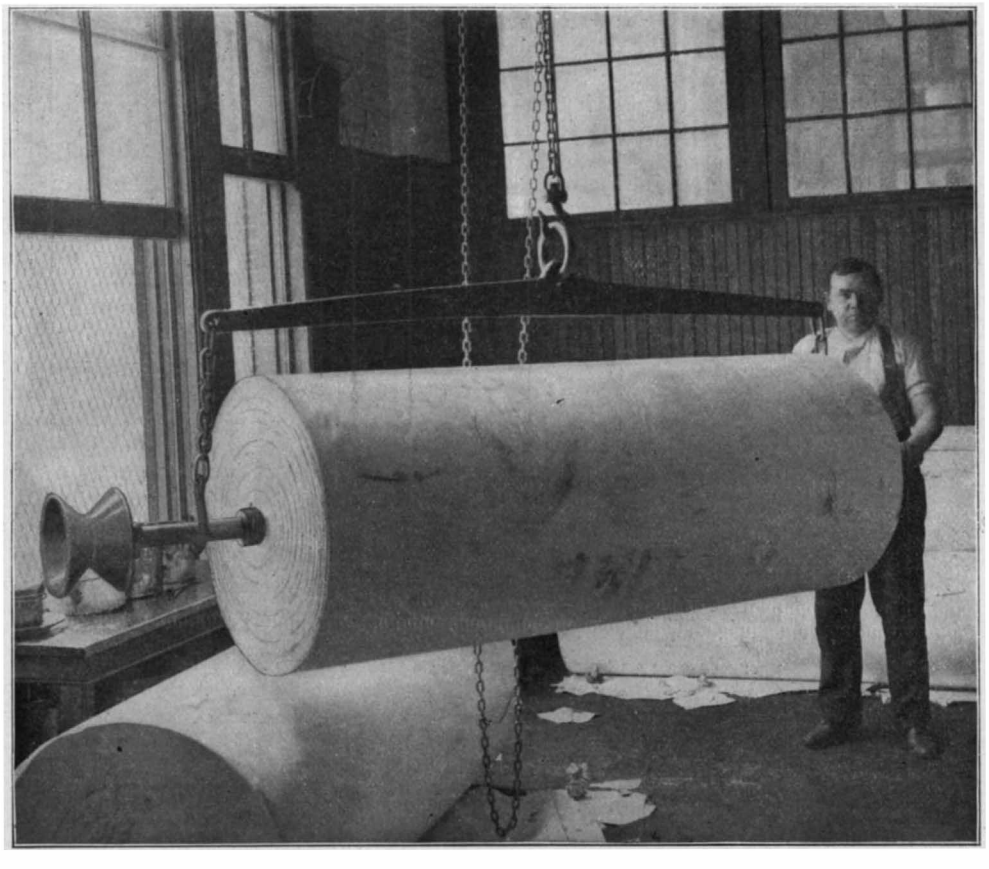
CURVED STEREOTYPE PLATES READY FOR THE PRESS.

FULL-PAGE PLATE OF A WEEKLY JOURNAL LOCKED UP IN A CHASE.

rolls the fibers are caused to interlace in various directions and give greater transverse strength to the texture. As the pulp is carried along on the wire cloth, much of the water drains through, leaving the fiber on the meshes. This first drying is usually hastened by various devices and the moist web is carried between rolls which are covered with woolen felt and then taken from the wire cloth on endless woolen felts which pass it between rolls and then to driers. These are large metal cylinders heated by steam. The paper has now acquired considerable strength. The water has been evaporated and the heated cylinders complete the drying process. The paper is then given a smooth surface by the calender rolls, which are smooth-faced heavy metal rollers. Finally the finished paper is reeled off in rolls and cut into sheets of the desired size. A large paper mill will make 250 tons of finished paper a day. The most modern machinery turns out a continuous web of finished paper at the rate of 500 feet a minute. The raw material of wood pulp is spruce, poplar, and in smaller quantities various other woods are employed. Wood pulp has to a great extent superseded the use of rags, and entirely so in the manufacture of news paper. The blocks of wood are pressed hydraulically against the edge of a rapidly revolving grindstone, and by attrition reduced to a mushy consistency.

There is also a chemical process of making wood pulp which is largely used. The merchantable shape of the fiber differs somewhat. Ground wood pulp is ordinarily sold in folded sheets only partially dry, and is, therefore, under common conditions, only suitable for use near the locality of its manufacture, its weight being so increased by the water as to preclude the profitable transportation of such a low-priced product. There are 763 paper-making plants in the United States and the total capital is $167,507,713, giving employment to 64,186 persons. The total cost of the materials used was $70,530,236, in 1900. The total value of the products was $127,326,162, and the total power required for running the plants was 764,847 horse power.

It has been estimated that nine novels had a total sale of 1,600,000 copies. This means 2,000,000 pounds of paper. We are assured by a manufacturer of paper that the average spruce tree yields a little less than half a cord of wood, which is equivalent to 500 pounds of paper. In other words, these nine novels swept away 4,000 trees. Is it any wonder that those interested in forestry look with anxiety upon the paper mill?



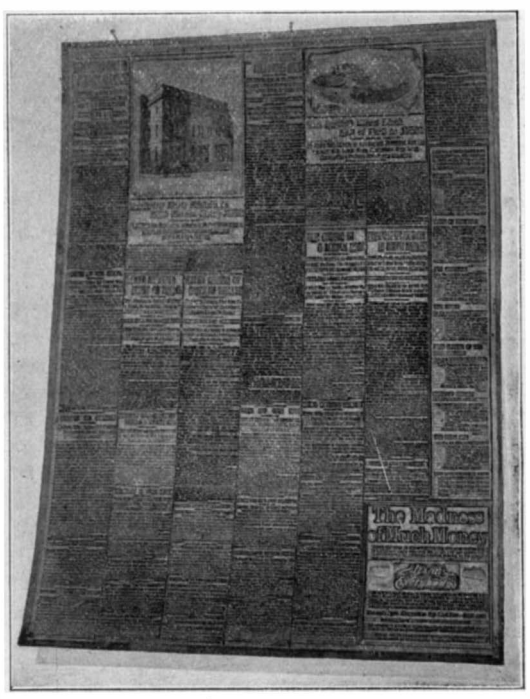
A ROLL OF PAPER 69 INCHES WIDE, READY FOR THE PRESS, OF ALL WEIGHTS FROM 700 TO 900 POUNDS. SUFFICIENT FOR 4,500 COPIES 24-PAGE PERIODICAL.

TYPE FOUNDING.

All early types were cast by hand one at a time, and the result was eminently satisfactory. Very large types are still cast in the same way. In 1822 a type-casting machine was introduced by David Bruce, and the changes in it were not very marked until the introduction of the Barth machine in 1888. A model for the punch cutter consists of a pencil sketch showing the letters 12 inches high. The drawing is reduced by a pantograph in the form of a model letter 3 inches high, with raised outline. An electrotype of this letter is then obtained and is fixed firmly upon the platform or table of the machine, beneath a tracing needle or index. To the head plate of this index are attached the four rods holding the cutting mechanism, which is at the top of the machine, and consists of a rapidly revolving borer, fixed in a stationary position and in a movable framework, in which is set the bar of steel or other metal which is to be cut. The leverage of the machine is capable of various adjustments, so that from the same model letter any body of type, from 2-point to 72-point, can be cut with equal facility and exactness.

The operator moves the index over the model letter on the platform, bearing down upon the lower parts and pressing against the sides of parts in high relief. The direction given to the index, at the will of the operator, upon the outlines of the model letter, is faithfully repeated by the tools cutting the punch. The cutting tools, of which two or three kinds are used in succession, are made with the utmost care. Being very highly tempered and being operated at very high speed, by steam power, they cut into the steel along the lines indicated by the movement of the guide over the model letter. The punches which are produced by this machine are finished in all points, requiring no hand work. Besides being produced more rapidly than those made by hand, these punches are more accurate, the counters are deeper, and the bevels are truer and always of uniform slope. This machine may be arranged to reproduce model letters in either direct or reverse order.

Where the punch is to be employed in making



MATRIX OF A PAGE OF A NEW YORK NEWSPAPER WAITING FOR THE AUTOPLATE TO STEREOTYPE IT.

matrices by the driving process, as is necessary for small characters, hard steel is used. The matrices for the larger characters are made from soft metal by the electrolytic process.

In the Barth type-casting machine, the half of the mold which carries the matrix is fixed immovably by a clamp in an upright position; the other half slides back and forth upon wide friction bearings, setting free the type that has just been cast and presenting again the mold mouthpiece to the nipple before the hot metal is injected for the next type. In order to prevent undue expansion of the mold, to get more accuracy in the type and to chill them quickly, a stream of cold water is carried in pipes through the fixed parts of the mold, and a current of air plays steadily on the matrix to keep it cool. The machine breaks off the gate, plows out the groove in the foot, removes the feather edges from the angles of each side, and delivers the types in serried rows upon sticks ready for the inspector.

At a meeting of the American Type Founders' Association in 1886, a committee was appointed to examine into and report upon the point system. There was some objection to the "pica" as a standard, but the majority of founders finally agreed to accept it as the basis of the point system. The twelfth part of a pica, called a point, was taken as a unit, and all bodies of type were placed on multiples of this

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point and called by numerical names: pica became 12-point; long primer, 10-point; brevier, 8-point; nonpareil, 6-point, etc. The present article is set in 8-point leaded.

THE AUTOPLATE.

In the SCIENTIFIC AMERICAN SUPPLEMENT for October 26, 1901, we had occasion to illustrate and describe a machine for making and finishing curved stereotype printing plates for use in printing newspapers, which had been but recently invented by Mr. H. A. Wise Wood, of New York, and first put into use upon the New York Herald.

It will be recalled that this machine—the autoplate—after a flexible papier maché matrix, made from a type page, is inserted therein, proceeds to cast printing plates, weighing about fifty pounds each, at the rate of four a minute, and to dress their edges and inner surfaces and prepare them for attachment to the printing cylinders, and that this is done automatically—all within the compass of one machine.

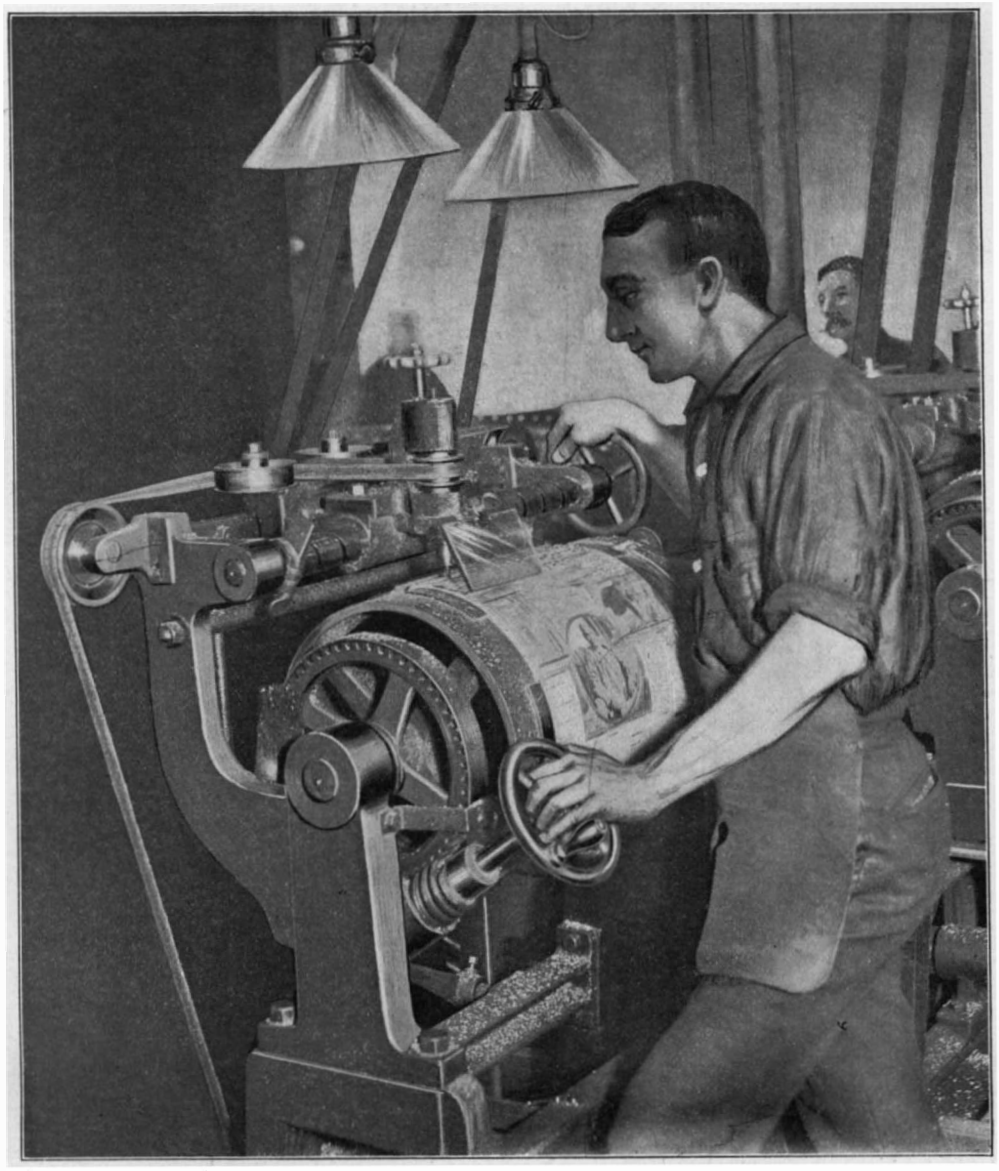
Previous to the advent of the autoplate such work had been invariably done by hand-worked devices, with which the fastest rate of production attainable was at the rate of slightly less than one plate per minute.

So great a change did this invention make in the work of stereotyping upon the larger newspapers, that not only was the machine generally adopted by the New York Herald, New York World, New York Times, Brooklyn Daily Eagle, Philadelphia Bulletin, Philadelphia Telegraph, Boston Post, Boston Globe, Chicago Tribune, and other papers, but in every case the hand apparatus were entirely dispensed with, and sole dependence placed upon the autoplate.

It will doubtless seem strange that so great a stride in so important an art should have been delayed until the very last year of the old century; but it was nevertheless the case that until Mr. Wood's machine came full-fledged into the stereotype room, not a single automatic device of any kind had been used therein for the production, or even for the finishing, of plates. How much such a device was needed may be realized when it is known that for the larger newspapers the saving in operating expense by means of the autoplate approximates $500 to $700 weekly; that its product in clearness of types and in beauty of illustrations far surpasses hand work; and that by reason of its celerity it is not only possible to hold pages open longer, and thus to print later news, but successive presses may be set running so much more quickly as to greatly increase the capacity of any given printing plant. So great is the last-mentioned benefit, that for an issue of a given size from one to two presses less need be run where autoplates are used; and even into the mailing and delivery room has the saving gone, for by reason of its now being possible to finish the printing of an issue earlier than formerly, much more time is left for the all-important work of distribution.

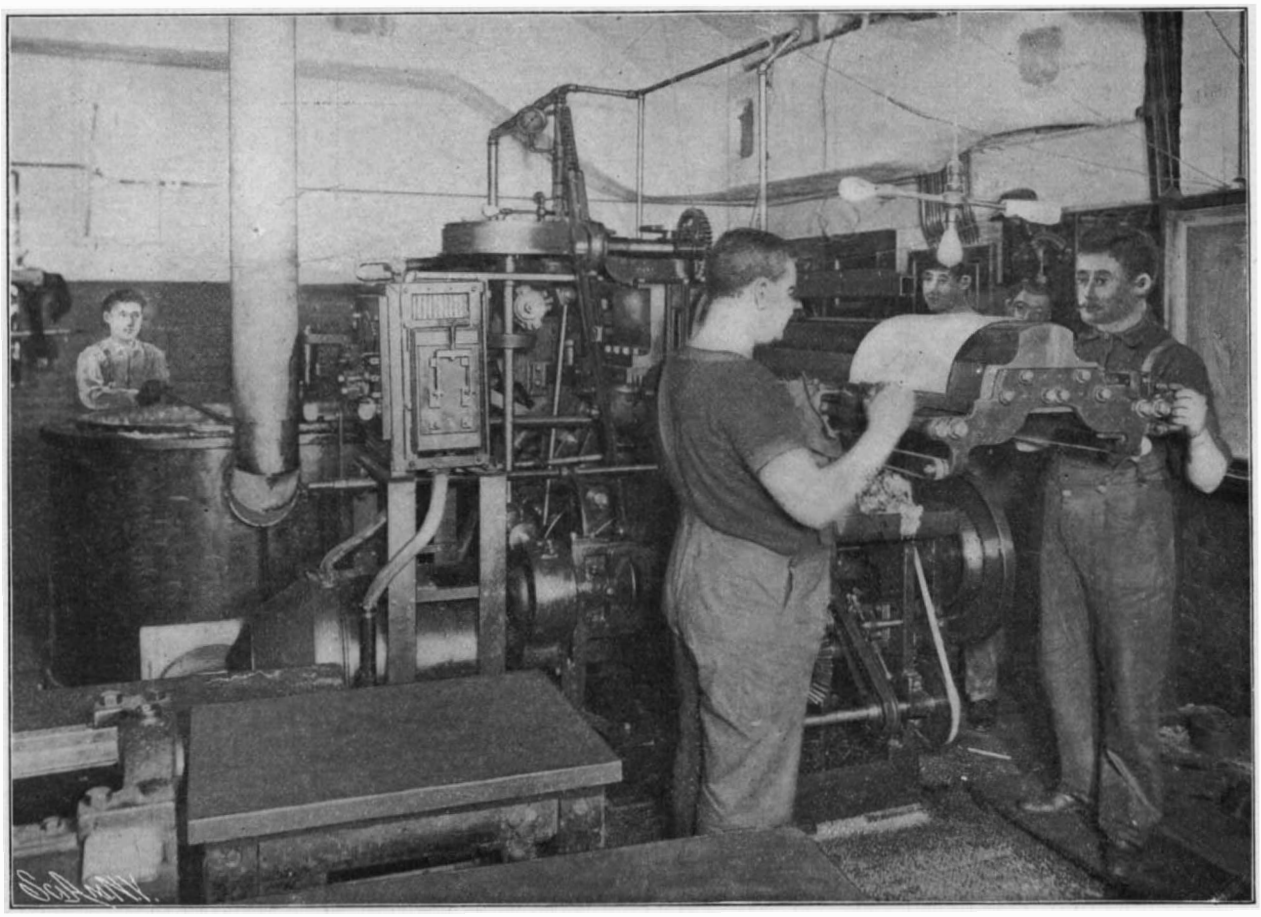
STEREOTYPING AND ELECTROTYPING.

The development of book and newspaper printing has been aided to an extraordinary degree by stereotyping and electrotyping. The stereotype plates or the matrices can be stored for future use at low expense and the type can be distributed and used anew. It was made practical by Earl Stanhope about 1804, and was introduced into New York in 1813. The plaster and clay processes were superseded in 1829 by the papier-maché process, in which a mold is taken on prepared paper, which is baked and which can then be curved, if necessary. Periodicals, other than dailies, and books are usually printed from electrotypes, which



ROUTING CURVED STEREOTYPE PLATES.

process was tried experimentally in New York in 1841 by Prof. Mapes. An impression is taken in specially prepared wax, and the mold is blackleaded to insure electrical contact. It is then placed in a plating bath and a shell of copper is deposited. This is stripped from the mold, curved if necessary, the back is tinned, and an alloy resembling type metal is then poured over it, to give it strength. The electrotype is then planed so that it will be type-high when blocked. Original half-tone cuts are often soldered or cast in to insure good printing results.



THE AUTOPLATE CASTS FOUR 50-POUND STEREOTYPES A MINUTE.—SAVES $500 A WEEK IN OPERATING EXPENSES AND ENABLES PAGES TO BE KEPT OPEN LONGER.

MACHINE COMPOSITION.

The linotype machine, invented by Ottmar Mergenthaler, may safely be said to have revolutionized the publication of newspapers. The linotype does away entirely with the foundry type and goes back to first principles—the block book. It produces a slug the length of a line with the various characters cast upon one edge. These slugs are locked up in forms like ordinary type. The linotype consists of a bank of keys connected with a magazine containing about 1,500 brass matrices, which are smooth plates about an inch high and a half inch wide, and of varying thickness. On one edge is a die from which is cast the letter, and at the upper end a series of nicks or teeth for distributing purposes, every character possessing a different combination. There are also spaces, molds, etc. The magazine containing the matrices is an inclined receptacle 2 feet 6 inches high, the top being 6 feet from the floor. Within this magazine are channels in which the matrices with the different letters are stored and through which they pass. The machine is so adjusted that as the type bar is manipulated, the matrices are selected in the order in which they are to appear in the slug or casting. When the operator depresses a key, the matrix to which it corresponds emerges from its channel, is caught upon an inclined traveling belt, and is then carried to the assembler, which corresponds to the ordinary printer's stick. As each word is completed, a stroke of the space key inserts the wedge-shaped space used between each two words. When the line is completed, the operator can correct errors by extracting matrices or substituting others for those which are in the line. The wedge-shaped spaces are now pushed up through the line, securing instantaneous and complete justification. The completed line is then transferred automatically to the front of a mold. Behind the mold is a melting pot containing a molten alloy resembling type metal. Within the pot is a pump plunger leading to a perforated mouth arranged to close the rear of the mold. When the matrix line is in position, the automatic operation of the plunger forces the metal into the mold and against the line of the matrix letters, where it instantly solidifies in the form of a slug. The mold wheel then makes a partial revolution which brings the mold in front of a blade which pushes the slug into a receiving galley. The slugs are type high and can be used in connection with ordinary type. The matrices are automatically returned to the magazine to be utilized in making new combinations. A change of face is easily effected by changing the matrices. By the aid of the new double-magazine linotype which we illustrated in the SCIENTIFIC AMERICAN for August 8, 1903, it is possible to set work in two faces of type, so that we can now set body letters, italics and full-face type on the same machine, changes being made instantaneously. Heretofore the type known as pica, or 12-point, has been the largest face of type which could be set on the machine; but it is now possible to make letters twice the size by casting one half of the character on one slug and the other half on a

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second slug. So accurate is the machine that not even an expert will notice the difference between a proof from the two slugs and from a foundry type.

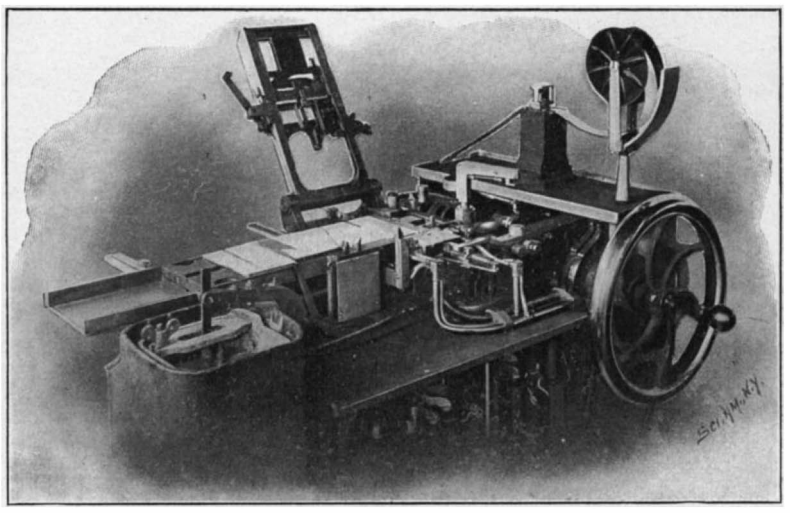
The average product of a good operator is 4,000 ems per hour, the measurement of type being based on the width of the character "m." Many operators, however, can set from 5,000 to 6,000 ems per hour and a speed of 13,000 is on record. About 1,000 new machines are put in operation each year, and they are in general use in the large newspaper offices in the United States, and are also largely used in Europe. The Lanston monotype machine has already been illustrated in the SUPPLEMENT, No. 1089, and the Dow composing machine in the issue of the SCIENTIFIC AMERICAN No. 3, vol. lxxxv. The Goodson graphotype is described below.

THE GRAPHOTYPE.

The use of electricity in individual type-casting and composing machines originated with the "Graphotype;" and the reader bearing in mind that there is no known power-producing agent that performs its work with such quickness so easily as electricity, can more readily understand why the graphotype can produce its work in such a small space and with such rapidity. Throughout the entire machine, wherever it is possible, instead of using heavy, cumbersome levers, cams, or other means of conveying power, the graphotype uses small wire cables, which give the quickest results. The work is produced in two operations. The first is done on the keyboard or composing machine, which makes perforations in paper tape that represent the characters or spaces struck by the operator; and when run through the second operation or casting machine, produces the type.

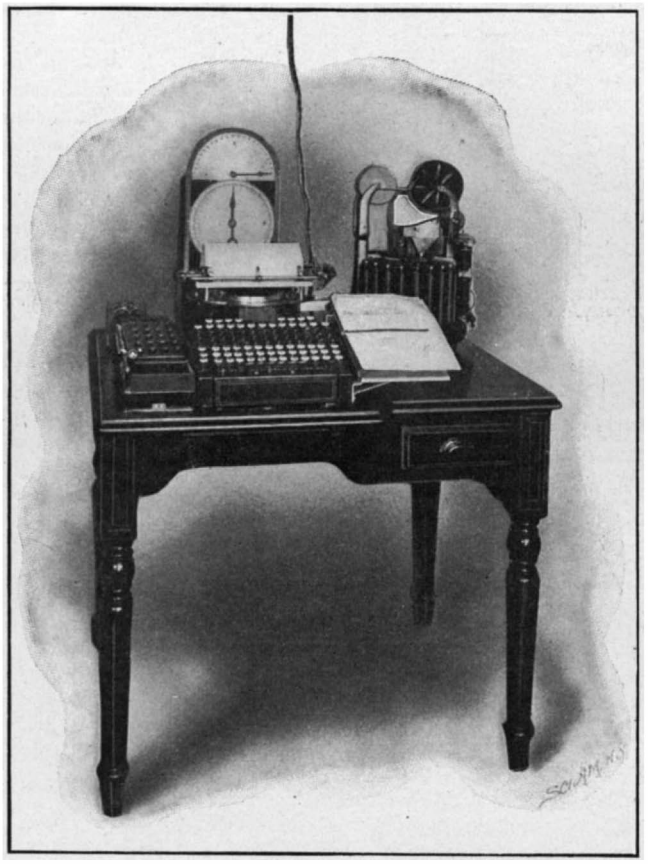
The keyboard is the part of the machine consisting of a typewriter electrically connected with perforating device and the counting or adding mechanism, all mounted on a neat table or stand to which is connected an ordinary flexible wire through which is fed a direct current at 110 volts. The typewriter is used to give a written copy as well as act as a keyboard for sending the message to the perforator device and counting mechanism. By actual use it is found that a typewritten copy is of great aid to the operator in case of interruption or tabulated work, as it enables him to see exactly what is done and what key has been struck last without looking at the tape or matrices, as in other machines. The perforator is a group of magnets, each of which is connected with a key or keys on the typewriter and operates small levers, which in turn operate the punches that perforate the paper, which, when taken to the caster after being automatically wound on a spool, produces from the perforations the exact character or space struck by the operator. The counting mechanism is nothing but a simple adjustable adding machine, with two dials one above the other (that can be set for any length of line within the scope of the machine), to notify the operator when the line is full and automatically give the justification, which is determined from the hand on the upper dial, this being set in motion when the line approaches completion. A strong feature in this machine is that, when the operator makes an error in a line, which often occurs on account of poor copy, interruptions, etc., he can, by pressing a certain key, make the casting machine automatically skip that line and begin where he wishes. The keyboard occupies about as much space and weighs about as much as a small typewriter desk, uses an ordinary manila paper about one inch wide, which requires no other preparation than to be cut in rolls of the required width, the feed or spur holes being cut as it passes through the perforator. The table can be moved around and used anywhere that the wires can be reached without being fastened in any way to the floor. The illustration shows this machine ready for use.

The caster is a small machine composed of the matrix, mold, metal pot, justifier, index head, and a number of magnets and a few cams and levers neatly mounted on an iron frame and driven by its own 1-6-horsepower motor. The paper tape is taken from the keyboard and passed through the index head, which has a number of index pins, each one of which drops through the proper perforation when it comes to it, making an electrical contact that transmits the current over a cable to a magnet or magnets, which operate pins that locate the matrix over the mold in the proper position for casting the character or space required, and at the same time set the mold for the size of the character or space called for. The mold and the matrix are then brought together, and a pump, which rests in the melting pot, is set in motion, forcing the metal through a small tube over a foot long into the mold, filling out the character or space in the matrix. The type being instantly chilled, the mold and matrix then separate, and the type is ejected into a slot. This operation is repeated until the line becomes the proper length, then this is moved forward into a galley; after this operation the type is handled in the ordinary way. The machine will set any size from 5½ to and including 12 point. In the caster there are many things that differ from all other machines. The tube through which the metal is conveyed from the melting pot to the mold is electrically heated, which enables the operator to regulate, by a rheostat, the temperature of the metal as it is delivered into the mold. It makes no difference what the condition of the metal in the pot is, as long as it is molten, the proper temperature is imparted to it as it passes through this tube. It obviates all trouble arising from the irregularities in gas pressure and change in temperature, caused by putting fresh pigs or type in the pot. The mold is water-jacketed in such a way as to insure the cooling of the largest type instantly.

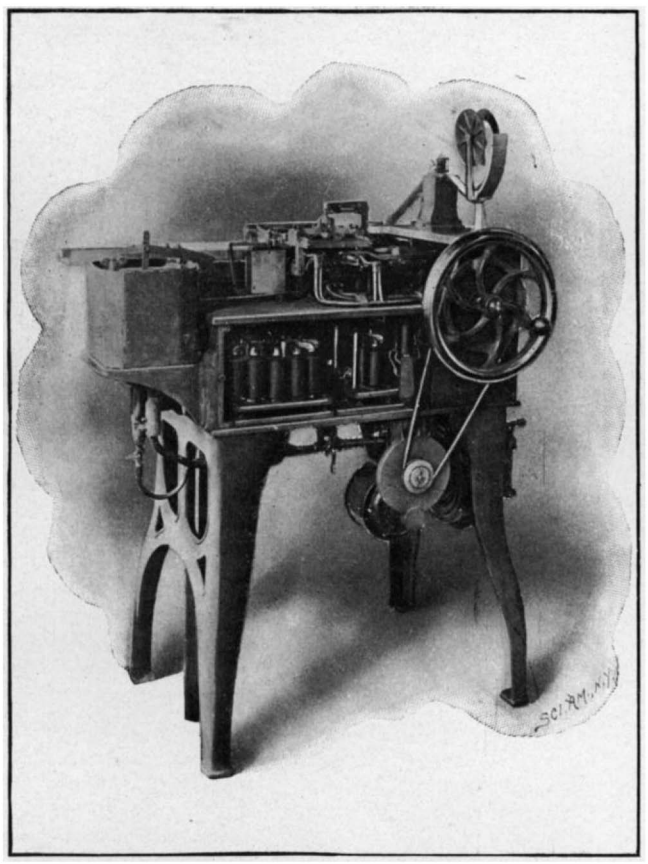


DETAIL VIEW OF CASTER WITH MATRIX UP.

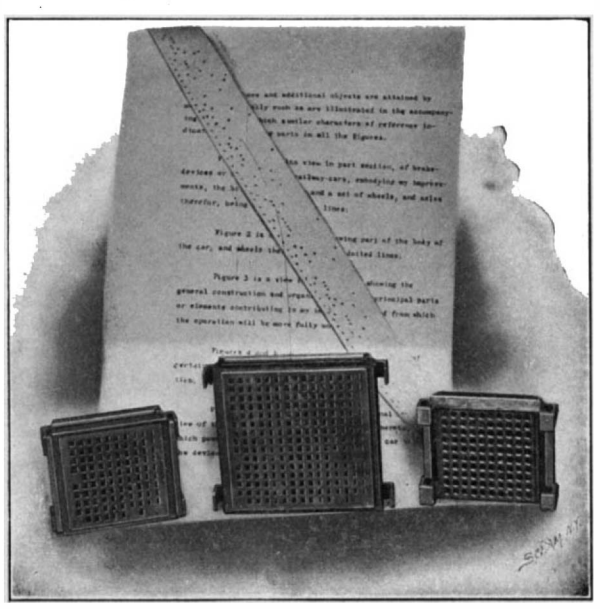
The matrix, which is practically indestructible, is made by a new process, which enables the company to make them at a phenomenally low price. It is as hard as steel, and at the same time not brittle enough to break. There are no knives or cutting edges in the mold to get dull, as the type is cast in such a peculiar way as to leave no gate or tail on the type. This feature alone makes the caster a very clean machine. The metal pot being such a long distance from the working parts, keeps the machine cool, and the fumes of the molten metal away from the operator. The justifier is a very simple electrical switch, which sends the current to a mold-size regulating pin to give the proper size space called for in the tape. This machine occupies 2 x 3 feet floor space, and weighs about 650 pounds. The illustration shows the machine in running order. There are no pulleys or belts to connect with it, as all the power is brought through the conduit, which is fastened on the back legs of the machine. This machine is so adjusted as to automatically stop on a line that is either a hair's space too long or short at the end of a tape, or an improper supply of metal. In fact, the machine is an automaton, that will cast, compose, and justify type. The detail engraving shows the matrix up, giving a view of the mold, type, and in fact nearly all the mechanical motions on the machine.



GRAPHOTYPE KEYBOARD.



GRAPHOTYPE CASTER.



TYPEWRITTEN SHEET, PERFORATED TAPE AND LARGE AND SMALL MATRICES.

The type has a very deep-cut face with deep counters or cups, which aid greatly in making plates and stereotypes and also keep the type from filling up when used directly on the press, and can be made either hard or soft by changing the properties of the metal. This deep-cut, sharp face is only obtained by using the new matrix process. As the type is made on the unit system, and each type or space is a multiple of a certain part of a pica em, and only six different sizes are used, the corrections are easily made, as the compositor can readily determine the size of the space by sight, which nearly always does away with the changing of all spaces in the line whenever the rejustification is required; neither does he have to put it in a stick, and type used for corrections is made on the machine.

This machine is owned and manufactured by the United States Graphotype Company, who have their main offices at 13-21 Park Row, New York. They also have an exhibit in New York, where a battery of eight machines has been running for over a year on commercial, book, magazine, and general work with very satisfactory results. This plan was adopted to give

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the machine a thorough test before putting it on the market, and save the purchaser a thousand and one annoyances that have heretofore come out with new machines. The present machine contains one hundred characters on the matrix, but has also auxiliary matrices for casting italic, small caps, heavy face, and all other "sorts" needed. The ordinary work, such as novel, magazine, catalogue, and tabulating, can be done to advantage on this machine, and it is small and rapid. A new and larger machine, containing all the above-named characters on one matrix, is being built, and in a short time that too will be on the market. One of our engravings shows the large and small matrices, typewritten copy, and a piece of the paper tape after being perforated.

THE INVENTION OF THE MODERN PRESS.

An extended account of the splendid achievements of Gutenberg must be relegated to such works as De Vinne's "Invention of Printing," where it more properly belongs. The primitive press was used from the time of the *incunabula* until the eighteenth century, when William Nicholson practically discovered modern printing machinery. He was an impractical person, but withal an inventor. To say that he was 75 years beyond his time would be no exaggeration. The invention of movable types is credited to the year 1436; the first really practical press, that of Blaew of Amsterdam. Benjamin Franklin worked on a hand press in London in 1725 and practically the same press is in use to-day by all photo-engravers for a proof-press. At the beginning of the nineteenth century Lord Stanhope invented a press composed of cast iron and provided with a toggle joint which facilitated the work. Taking the subject broadly, however, we are inclined to give the credit of the modern printing press to William Nicholson, for his English patent certainly foreshadows many of the modern improvements. We may regard him as a Watt, although it took a Stephenson half a century later to develop his ideas.

The cylinder press was introduced in 1812. Various improvements were invented, and in 1814 the first press was driven by steam. In the same year the London Times put in a press the pieces of which were carried in by stealth to an adjoining building, owing to the avowed hostility of the workmen. At six o'clock, while the pressmen were waiting for the forms, Mr. Walter entered the pressroom and astonished its occupants by telling them that the Times was already printed by steam, and that if they attempted violence he had an adequate force to suppress it, but if they were peaceable they would be retained. The speed was 1,100 an hour! The curved stereotype was invented in 1816 and the improvements all tended to produce the modern press which is an evolution rather than a concrete invention. In 1848 Col. Hoe introduced his huge ten-feeder press, which in point of size was equal to the great modern double-sextuple newspaper presses. The capacity of the earlier machines was 2,000 per hour, while those of to-day print and fold 150 000 eight-page papers an hour.

Prior to 1870 printing presses were largely of two types—the platen job press, in which the impression was made by direct pressure, and the cylinder press, consisting of a flat bed which held the type form in a horizontal position, and was carried back and forth mechanically beneath a large revolving drum carrying upon a segment of its surface the sheet to be printed. There are four kinds of cylinder presses in use—the drum cylinder, the double cylinder, the stop cylinder, and the two-revolution cylinder. The last is now regarded with the greatest favor as far as speed is concerned. The double cylinder was evolved from the old-fashioned drum cylinder. By a duplication of the cylinders the capacity of the press was doubled; they worked alternately. The stop-cylinder press was so called because the cylinder stops at a certain point in its revolution, thus permitting of great accuracy in feeding and in the amount of color that can be carried. This press is especially adapted for color and art work requiring perfect registry. It has now been to some extent supplanted by the two-revolution press, where the cylinder is smaller and revolves twice at each impression, once in contact with the type and again in a slightly elevated position, while the sheet is being released and the form returned to its proper position. The details of presses, such as adjustment and ink distribution, have received special attention from inventors of printing machinery. The web perfecting press has now been improved so that it can be used for very fine work. In these presses a roll or web of paper passes into the press, and is printed or "perfected" on both sides before being cut and folded. We refer below to very large perfecting presses for newspaper work; but they are used for magazine and book work as well. It requires more time to make ready with a perfecting press, but there is, of course, a great gain in speed when the press is started. One of the large illustrated weeklies is now installing a battery of presses to take the place of perfecting presses. In these new machines feeding is done automatically. The cylinder is of very large size, and half of it is devoted to the printing plates, which are secured to its surface. The remainder of it is used as a distributing table for the ink. The great extent of ink surface makes it possible for the rollers, which are brought in contact with it, to obtain a perfect distribution of ink. It is expected that presses of this type will supplant the perfecting presses for very fine work. They are called art presses.

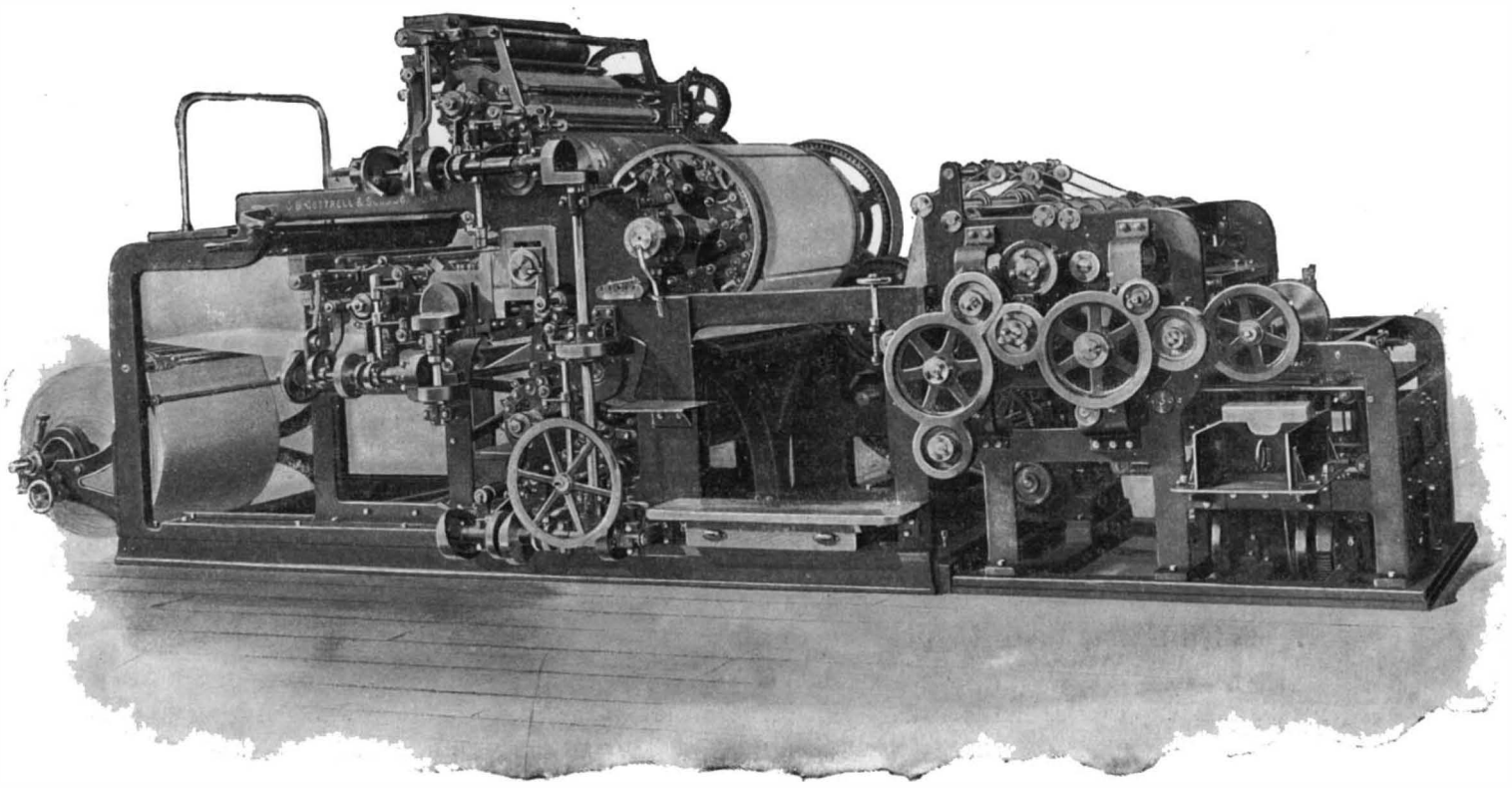
Great improvements have been made in job presses. One of the new automatic job presses has a speed of from 5,000 to 14,000 impressions per hour, the feeding being done automatically. Paper feeders have come into very general use. We illustrated one in the SCIENTIFIC AMERICAN for August 29, 1903, and two of our illustrations show the same feeder in place on printing machinery. Press manufacturers built their machines faster and faster, so that in time the feeder was unable to cope with the press. This opened a field for the automatic supply of paper, thus increasing the output from 30 to 40 per cent. The use of paper feeders has minimized the liability of strikes. The continuous use of the press adds greatly to the increase in the output. The feeder can be loaded with paper at any time, and the capacity of the paper truck is very large, 20,000 sheets not being unusual. The mechanism is described in detail in the article already cited.

THE NEWSPAPER PRESS.

The Hoe double-sextuple printing presses are veritable triumphs of mechanical art. This machine is really composed of two separate complete printing mechanisms, each fed from three four-page-wide rolls of paper. The machinery for the gathering and folding of these webs of paper is in the center between the two sections of the machine. Each of the two portions of the machine is composed of six pairs of cylinders arranged with their axles parallel, in three tiers of two pairs each. They print on both sides of three webs of paper from separate rolls which are each four pages wide. One of these sections is so arranged that all six sets of cylinders will print upon a single web in colors and black, this web being associated with the three webs from the other portions in order to form a colored cover. Each section of the machine may be operated independently, if desired. There are twelve plate cylinders in the machine, each carrying eight plates the size of a newspaper page, and either stereotypes or electrotypes may be used. The ink is applied to the plates by four form rollers after having been thoroughly distributed by means of vibrating rollers and cylinders.

The immense press measures 35 feet long, is 9 feet wide, 17 feet high, and weighs about 225,000 pounds. The number of parts of which it is composed is approximately 50,000.

The capacity of the machine when printing all black from six rolls is equivalent to 150,000 four, six, or eight-page papers per hour. If the size of the paper is increased to twenty-four pages the press will still print 50,000 per hour. The three webs from each part of the machine are led to the top of the folder, where they are divided along their center line into webs two pages wide, and then run down each of the four formers by which they are folded along their centers. They are then led to cylinders which cut them into page lengths and give them a fold across the page to half-page size. This is one method of running a twenty-four-page paper. When running as a color press the maximum product is 50,000 sixteen-page papers per hour, the outside pages being printed in four colors and black, and the other pages in black only. It is most interesting to see one of these great presses at work. A number of men are required to operate it, and they communicate with each other by bells. The folded and counted papers are delivered so fast that it is almost impossible for the men to take them away fast enough. In the case of one large New York daily five miniature elevators are required to raise the papers to the street level for delivery to wagons and to the newsboys.



PRESS FOR MAGAZINE WORK.—THE SHIFTING TYMPAN PREVENTS OFFSETTING OF THE INK IMPRESSION.

MAGAZINE AND BOOK PRESSES.

The development of the web press and folder for printing and folding illustrated magazine work has been difficult, on account of the quality of printing on highly-finished papers and the necessarily accurate registry of the folding required, as well as the handling in the folder of the freshly-printed web without smutting. The incentive for the development of this class of web press is found in the growth of the illustrated monthly publications, improvement in the half-tone process, and the demand of publishers for a better quality of printing and folding at higher speeds than can be accomplished by a sheet-fed press and a sheet-fed folder. We illustrate one type—the Cottrell.

The tympan sheet is an extra sheet of paper stretched over the second impression cylinder, make-ready, or packing, to take the offset of extra ink from the first side of the web printed, and the automatic shifting tympan mechanism is adapted for the self-shifting of this tympan sheet.

This mechanism has first the ability to change the tympan in one second of time, while the press is running at a high speed, and secondly, the ability to have

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this entire new tympan as often as required. Going over these points of the invention again, the entire tympan changes itself, so that you have a brand-new tympan in an instant. It does this between impressions, while the press is running at a high rate of speed, and it will do it as often as you wish.

The tympan mechanism consists of rolls of this manila paper located just inside of the openings in the cylinder. The paper comes out through these openings, passes across the quarter sections of the impression surface of the cylinder, and is drawn in through another opening in the cylinder onto other rolls. It winds itself automatically from one roll to another, across the impression surface of the cylinder, but instead of moving slowly it travels across the entire surface of the cylinder in one quick movement between impressions, giving an entirely new tympan surface.

The tympan mechanism can be set to shift in this way once every 10, 20, 30, and up to 150 impressions as the form may require, and thus it goes on automatically, requiring no attention as long as the press itself is kept in operation.

A roll of tympan paper lasts a day on fine work, or on common work for a longer period; it can then be used again and again—allowing time to dry. The shifting tympan or the tympan sheet acts in place of a blotter to take up from the freshly-printed surfaces or surface such portion of the ink as is not impressed in the paper surface and is not necessary to make an absolutely black impression. The web after being printed is carried by its margins to the folder, where it is cut into sheets, folded without the use of folding rollers, and delivered without any portion of the printed surface coming in contact with any part of the mechanism.

The Miehle press for general work shown is of the flat-bed, two-revolution style and known to printers by this description. The bed carrying the type reciprocates under the cylinder, printing on one revolution of the cylinder and returning to its original position on the second revolution of the press, which also gives time for the handling of the sheet by fly or other delivery, and gives time also for the re-inking of the form, the distribution of the ink, etc. This style of press also permits the tripping of the cylinder in case the feeder should fail to present a sheet at the right time, thus saving the printing on the cylinder and the offset that ensues.

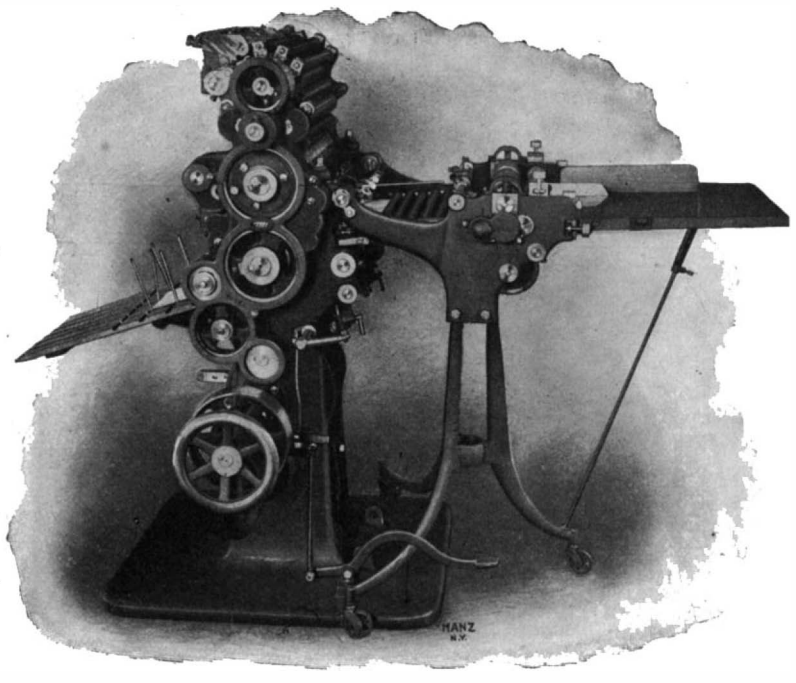
The special feature of this press is the new bed movement. Probably no part of the cylinder press has been the subject of so much experiment as the mechanism for propelling the type bed back and forth under the cylinder. Of the numerous devices invented, comparatively few have developed merit sufficient to attain any permanent adoption.

The movement of the bed under the cylinder is even throughout; the avoidance of any eccentric movement permits of an even quality of work throughout the line of impression, permits of its finest register work, like three-color or similar work requiring accuracy. The press prints at one time eight complete covers of a large magazine which are equal to thirty-two pages quarto book form, one impression carrying a sheet 48 x 68 inches, and it is at the Collier Press.

AUTOMATIC JOBBING PRESS.

It is an entirely automatic machine. The stock being dropped by handfuls into the hopper, the press delivers it admirably well printed, in such a convenient form for ready removal that one hand can operate the machine entirely unassisted on all speeds up to twelve thousand per hour. Indeed, there are many operators competent to handle the press at fourteen thousand per hour. The press is automatic to such an extent that if left alone it will stop itself when it has printed all the stock in the hopper. If for any cause a piece of stock fails to feed, the press throws off its impression automatically, so that the tympan receives no ink to offset the next piece of stock that goes through. At the same time the press stops itself. To start it again is practically an instantaneous process. The Harris press is a small machine, occupying a floor space of 3½ x 5 feet. It ordinarily takes but one-half horse power to run it.

It is possible to make 250 changes of type forms a day, and still run off 50,000 impressions where it is not necessary to "make-ready." It feeds cut sheets of paper in all sizes of stock from 4 x 6 inches up to and including 15 x 18 inches. It prints in one or two colors at once a curved electrotype or stereotype form in all sizes from a single letter up to and including 14 x 17 inches, and one or two type forms in turtles, each holding a form up to 4⅞ x 8⅝ inches.

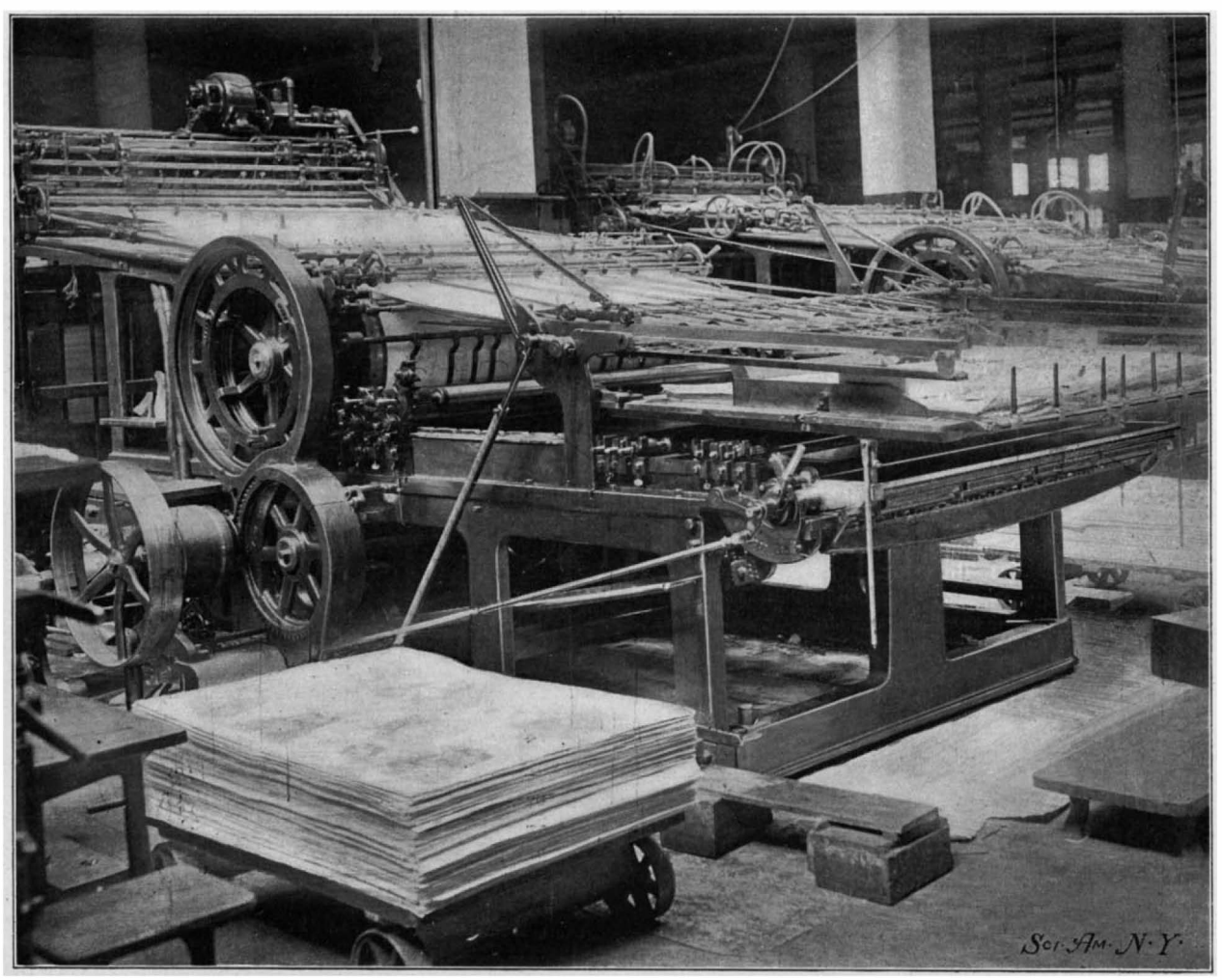


THE HARRIS AUTOMATIC PRESS FOR PRINTING CIRCULARS, NOTICES, ETC.—FEEDS ITSELF FROM A HOPPER.

The normal running speed on a full form is 6,500 impressions per hour. The maximum speed is 10,000 an hour.

The feeder is accurate and reliable, involving no use of air, no electricity, and no buckling, crimping or doubling of the paper. The sheets are not pushed forward from the top of the pile, but are pulled out by the front edge from underneath the pile. It requires very little adjusting for various weights of paper or for changes in the size of stock. The separating mechanism is rotary. The stock being fed from the bottom, the pile is replenished without stopping or in any way delaying the machine.

The feeder is provided with a choke to prevent more than one sheet at a time reaching the form, and a trip, or automatic throw-off, which stops the press and separates the two cylinders to prevent the form from smutting the tympan whenever a sheet fails to feed from any cause whatever. This makes the press practically "fool-proof;" so that after a good, competent pressman has made a form ready and started the job, the cheapest intelligent labor in the shop can perform the work of loading up the stock pile, watching the color and removing printed sheets.



A TWO-REVOLUTION PRESS FOR WEEKLY OR MONTHLY MAGAZINE WORK.

Ink and Rollers.

Ink and rollers are two of the most important articles connected with printing. Printing ink is a pigment of the required color mixed with an oil or varnish. It must distribute freely and easily, work sharp and clear, and not be affected to any great extent by atmospheric conditions. It must dry almost immediately on the paper, but not dry at all on the type or rollers. The basis for the best black ink is lampblack and the vehicle is usually linseed oil. Many pigments are used to produce printing inks of different colors. Printers' rollers are diverse in their composition, each maker having his own formula. The following is a typical formula:

Best glue	10½ pounds
Black molasses or honey	2½ gallons
India rubber, dissolved in oil of turpentine	1 pound
Venice turpentine	2 ounces
Glycerine	12 ounces
Vinegar	4 ounces

The above formula is given for the mysterious black composition, so durable and elastic. Purified and unvulcanized India rubber only is used.

In a printing establishment in New York city two motors are in use, a 15-horsepower gas engine and a 25-horsepower electric motor. The average load carried is only about 10 horse power. Comparison has been made two months, when the gas engine alone was used, and two other months, when the electric motor alone was in service. Gas is taken from the city illuminating mains and costs $1.05 per 1,000 cubic feet. The engine was run a total of 697 hours, and the gas consumed cost $106.68, or an average of 15.3 cents per hour, which is about 1½ cents per horse-power hour. Electric current is taken from the Edison mains, and the amount used during the 686 hours of operation of the motor amounted to $250.30, or an average of 36.5 cents per hour, which is about 3½ cents per horse-power hour.

Lithographic Color Printing.

A widespread but unsuccessful attempt was made, about 1880, to substitute zinc for stone in lithographic work. After this failure, zinc was generally abandoned as a factor in the lithographic problem, but one firm has continued to make experiments along this line with considerable success.

In 1898 the great superiority of aluminium over lithographic stone was demonstrated. Aluminium is far lighter, requires less space for storage, is cheaper, is almost non-corrosive, can be used in sheets upon rotary presses, can be used for longer runs without reproduction of the design, and after some manipulation possesses all the desirable qualities of stone.

The methods of manipulation are two. By the first, the surface of a sheet of fine-rolled aluminium is ground off, producing a porous surface. The second method is the formation of an aluminium surface by electro-deposition.

The effect of the extraordinary activity in invention and improvement in the printing world since 1880, has been twofold. To the printer himself it has been injurious rather than helpful; to the public it has been of incalculable advantage and has been a potent factor in elevating the standards of good taste.

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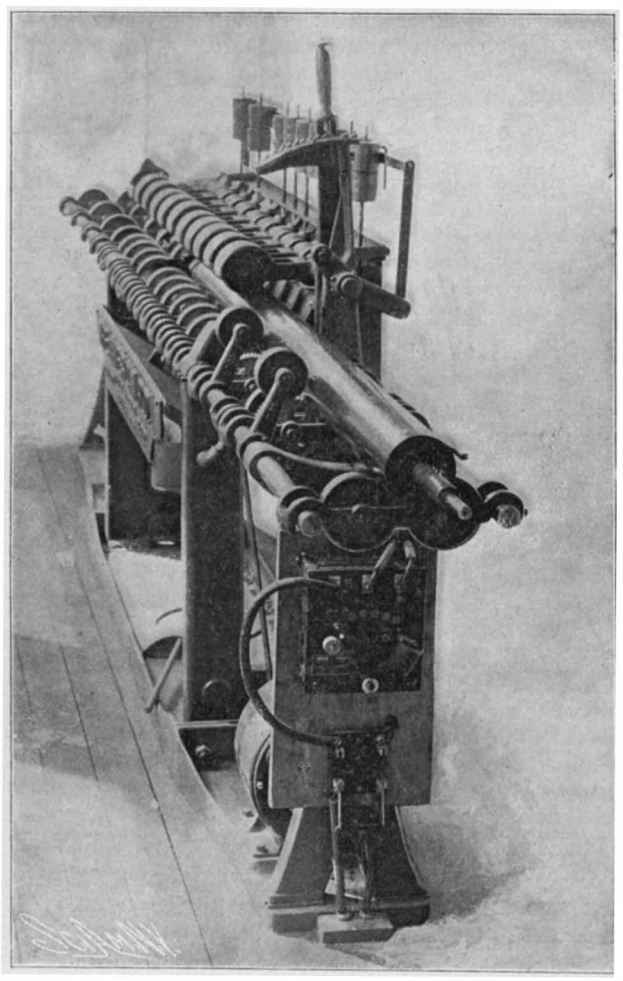
MECHANICAL "PRINTER'S DEVILS."

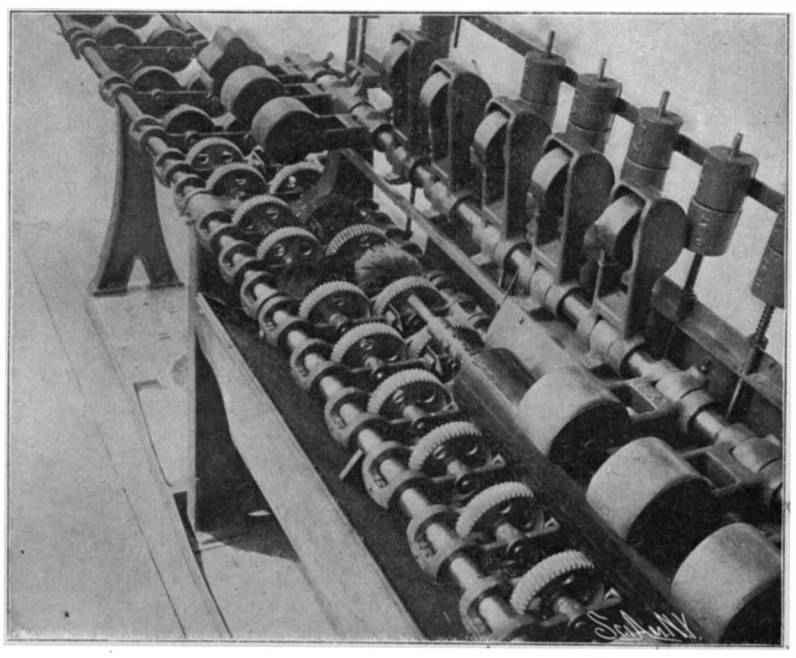
A "printer's devil" is to the lay mind the errand boy who comes for copy and brings proof. In reality he is nothing of the kind; a "printer's devil" is a roller cleaner, and at the end of the run or day he washes the ink from the composition rollers and puts them in boxes. Heretofore hand work has been used, probably because no satisfactory machine for doing the work had been invented. Now, however, a mechanical washer has been devised which will clean the rollers of eighteen presses.

The machine consists of a bed, to which are secured the various parts of the mechanism, an oil pump and a motor, which serves to actuate it. The lever at the top serves to set the machine for cleaning rollers from 1½ to 4½ inches in diameter; it raises or lowers tension rollers which are carried in gear cases. Each roller is counterweighted by divided weights, the upper section being provided with a hook which raises the upper weight when the rear bar is raised for washing small rollers. The roller feeds itself in, after once being laid on the bed, by the propelling or massage wheels, which are disposed in pairs throughout the central section of the machine. These wheels are set at an angle and serve to knead or massage the surface of the roller. Scrapers disposed vertically between the propelling or massage rollers take off the color, and at last it reaches a rotary brush which is opposed to a wheel made of sheets of leather; this empties all low places, cleans both ends and brings the solvent to the surface for the scrapers to remove, and it runs out on the delivery rollers dry and free from specks. The solvent used is kerosene oil, which is applied by the massage rollers. The foul oil runs down into a trough and thence into a pail having a wire cloth division. The oil enters one side, is filtered and is pumped up again by a rotary pump and used. The machine saves benzine and rags and above all the time of the press. This machine, like the lithographic washer, is made by the Printer's Roller Washing Machine Company, New York city.

Lithographic rollers differ from type rollers in that they are covered with leather, neatly joined. The surface must have the nap, if leather can be said to have a nap, raised so as to give it a hairy appearance. This, by hand work, is done by a scraper and sandpaper. It will be readily seen that the washing and graining of these leather rollers must be a long and tedious process. The machine consists of a long bed with a head stock, a tail stock and a movable carriage containing the scraper and grainer. The carriage is hauled back and forth by a chain. The roller is placed in position and clamped and the machine is started. The knives or scrapers, as will be seen in our detail engraving, where a portion has been broken away to show them, are six in number. These knives can be advanced toward the center like an iris diaphragm. One of the massage rollers will be seen in the center. The turpentine or other solvents are supplied unstintedly and practically cost nothing, as they are fed to the massage rollers, which work directly upon the surface of the roller, regardless of how old and hard it may be.

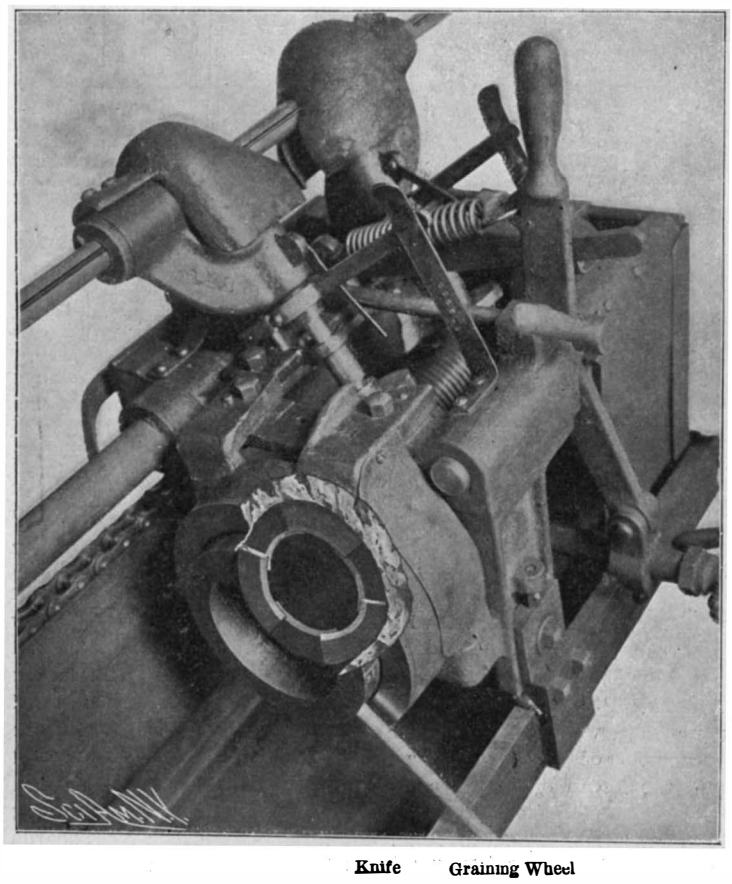


A MECHANICAL "PRINTER'S DEVIL."—WASHES ROLLERS FOR EIGHTEEN PRESSES.



Brush Massage Wheels Roller

DETAIL OF THE TYPOGRAPHIC ROLLER WASHER.

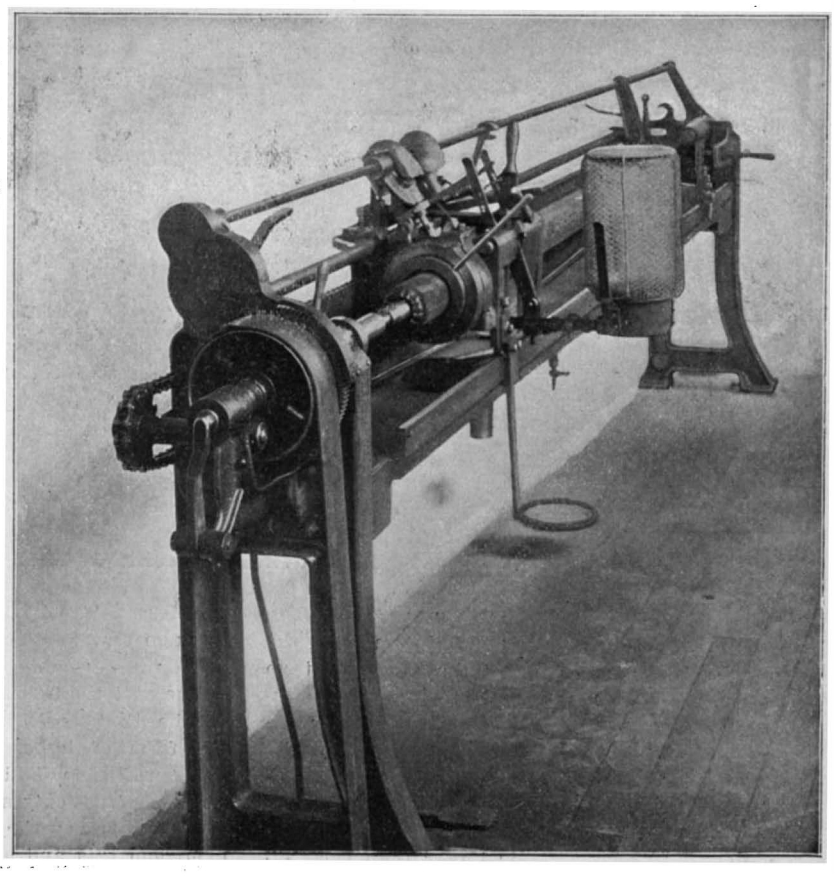


Knife Graining Wheel

DETAIL OF THE LITHOGRAPHIC ROLLER WASHER.

The scraping device follows, which grasps the full circumference and at one cut the turpentine and color is exudated and dropped into a catch basin, which in turn drains into the supply bottles and is employed again and again for rollers caked with the same colored ink. Each color has a separate tank, so as to favor the separation by gravity and quickly allow the turpentine to come to the surface.

The rollers are now ready to grain. Small disks are disposed over the roller. These have each four saw teeth inserted in them. They are rotated at a thousand revolutions a minute by the medium of a shaft and bevel gears. Power is derived from a slotted shaft which permits the bevel gears to move with the carriage. The roller is run under the grainer, which gives it its slightly hairy surface. The machine turns out a dry, clean roller, untouched by sandpaper and rags; consequently free from lint. The operator can work with clean hands. The saving in time is very great, as the machine will do the work in one-fifth the time and the waste of leather is reduced to a minimum.



AUTOMATIC LITHOGRAPHIC WASHER AND GRAINER.

Newspaper Syndicates.

An extension of the scope of the newspaper, during the last twenty years, to include subjects of more lasting interest, led to the creation and extension of the so-called "syndicate," which furnishes papers with miscellaneous reading matter, as the news-gathering association furnishes them with news. The syndicate was introduced about 1884, for the purchase and sale of stories, but has since extended its field to all sorts of reading matter. While the news-gathering associations are largely co-operative, the syndicate is purely a proprietary affair, buying articles from authors and selling them outright to the different newspapers on their list of customers.

Some syndicate matter is sent out in matrix form, but most of it is supplied in the shape of galley proof, to be set up in the office of the newspaper purchasing it, in the general style of the paper.

Most of the syndicate material is prepared especially for the Sunday supplement or magazine part of a newspaper, but the syndicates will furnish almost any class of articles found in daily papers. In making sales, the syndicate has a fixed price for articles, and although it disposes of the same stories or other matter to a number of papers, only one in each city or field of publication may receive a given story or article.

The syndicate is enabled, by its sales of the same article to many customers, to purchase matter quite out of the reach of the individual newspaper, and to sell it on terms that each can afford. The scheme is found to be so advantageous that to-day practically all the newspapers of the country, except some in a few of the largest cities, use syndicate matter to a considerable extent.

Besides the firms engaged primarily in the syndicate business, certain leading metropolitan newspapers dispose of their own matter to papers published elsewhere.

The Rapid Extension in the Gathering of News.

In 1886 the New York World reported the battle of Majuba Hill in six lines, but so rapid was the extension of news gathering that, fourteen years later, events in the same quarter of the globe were reported to the great American dailies by cable as fully as though close at hand. The destruction of St. Pierre, Martinique, in 1902, by an eruption of Mont Pelee, may be mentioned as an illustration of this tendency. Cablegrams concerning that great disaster reached American newspapers by way of Brazil, the Azores, and Great Britain, costing the recipients from $2 to $4 per word, with fees for precedence.

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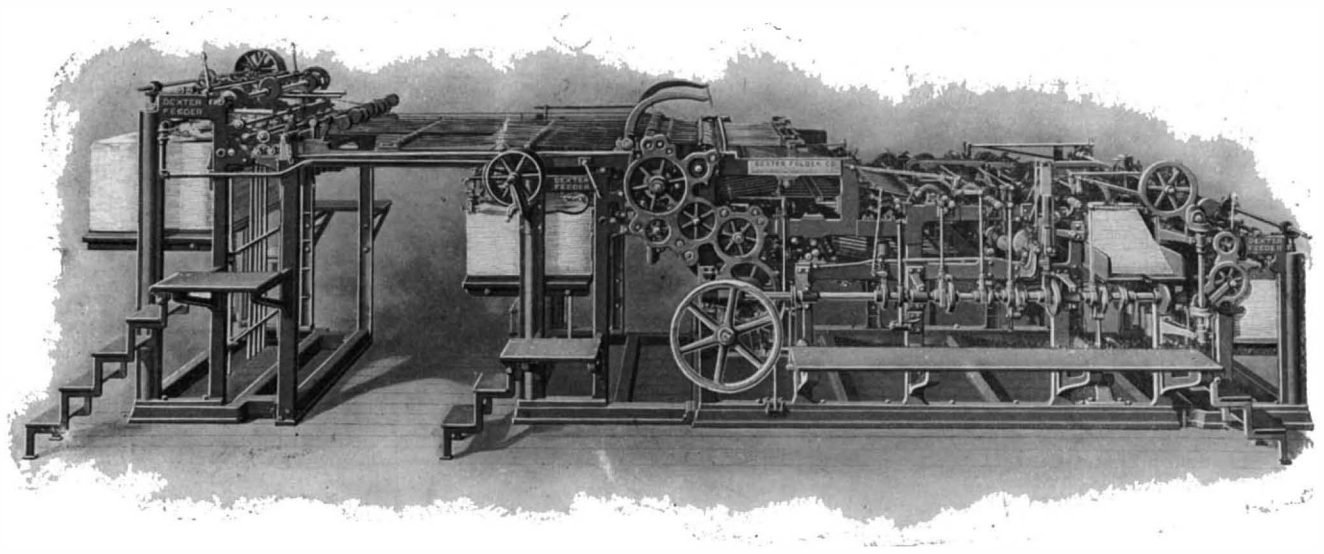
COMBINATION FOLDING AND WIRE-STITCHING MACHINE.

This machine marks another revolution in the method or process of handling, putting together, and making of a periodical. In a continuous and strictly automatic operation it takes the sheets from the platforms of as many as five feeders in one machine (representing as many separate sheets), folds, gathers, collates, covers, and wire-stitches them, delivering completed copies without intermediate handling.

The accompanying illustration represents the machine receiving from the automatic feeders three separate sheets, the two main sheets making up the body of the periodical, the third sheet being the cover. These machines took the place of sixteen folding machines of ordinary make, to each of which was attached an automatic feeding machine; also ten thread sewing machines, and did away with the help of sixty employes, who were formerly necessary to assemble by hand and stitch the immense edition of a popular periodical. Since that time, however, machines of a similar construction have been made which are designed to receive, bring together, and turn out a periodical made up of five separate sheets. Three such machines are now in course of construction for an illustrated weekly.



FOLDER AND WIRE STITCHER.—FEEDS ITSELF AUTOMATICALLY.

Thirty-seven feet long, weighs fifteen tons and does away with sixteen folding machines and sixty employes.

The main sheets are each first fed from the feeding machine to the folder, where they are partially folded, and then carried to the assembling gage in the machine, where they are met by the cover. At this point the several sheets are independently registered with each other, and are then carried into position for receiving the wire staples, after which they pass into position for receiving the last fold. If either sheet should be missing at the assembling gage, the incomplete copy will be switched out of its course into a receptacle provided for it. This automatic switch, at the same time, trips the wire stitchers, so they do not operate unless the copy is complete, thus preventing the possibility of any but complete copies reaching the packing box.

As a further idea of the completeness of these machines, it should be explained that should either of the feeding machines advance more than one sheet at a time, the automatic features of the folding machine are brought into play in practically the same way that they would be if the feeding machine had failed to advance a single sheet; in other words, if either of the feeding machines advances more than one sheet at a time, the sheet will be automatically switched out of its course, the stitchers automatically tripped, so that such copy will not be wire-stitched.

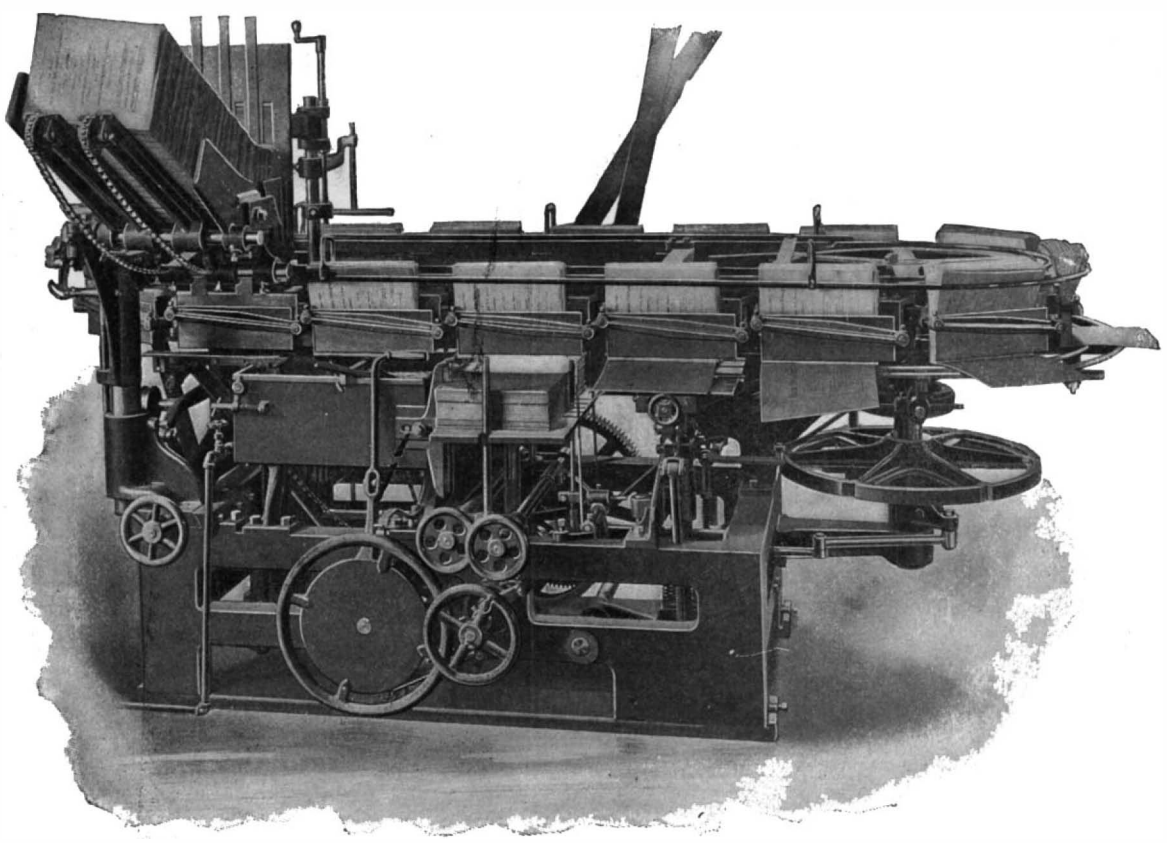
In dimensions, the very latest of these machines cover a floor space of 37 feet in length by about 12 feet in width, and weigh about 15 tons.

On highly illustrated periodicals the use of this type of machine enables the publisher to use a grade of paper and do a class of printing that has heretofore been prohibited where it was attempted to do printing and folding at one operation. By this process the sheets are allowed to dry before going to the folding machine, and as the machine receives at one time all the sheets that go into the periodical, the work of getting out a completed book proceeds very rapidly and, at the same time, economically. This machine is made by the Dexter Folder Company, of New York.

The Louisiana Purchase Exposition covers two square miles—1,240 acres. It is larger than the Chicago, Omaha, Buffalo, and Paris expositions combined.

BOOK-COVERING MACHINE FOR APPLYING PAPER COVERS TO BOOKS, PAMPHLETS, AND MAGAZINES.

By looking at the cut of this machine it will be noticed that the books are placed in the receiving trough, and are fed automatically to the jaws, which are operated by a cam movement and springs. At a given point the jaw is opened automatically, and after receiving the book closes automatically, moving the book forward to the glue wheel, which applies the glue to the book. From this position the book is moved one step forward to the cover box, containing covers, and, while running, the cover box raises up and applies one cover to the back of the book. The cover box then proceeds with one movement forward to what is termed the cover breaker. This cover breaker lifts up the book, pressing the cover against the back of the book and at the same motion side lips are moved inwardly to form a joint or crease on the cover. The book then passes from step to step, as seen in the illustration, with the cover flying until it has reached the delivery point, where the jaws open automatically and allow the book to fall down on a table, and it is then pushed out of the way by a plunger, so that the next book may fall down without interruption. The machine will cover books or pamphlets from ¼ inch up to 1½ inches thick and up to 12 inches long at the rate of 2,250 books per hour. By its use is saved, over the old way of covering by hand, in floor space nearly 50 per cent and in cost of operation and maintenance over 80 per cent. It is manufactured and sold by Messrs. T. W. and C. B. Sheridan, of New York, Chicago and London.



BOOK-COVERING MACHINE.—WILL COVER 2,250 BOOKS OR MAGAZINES PER HOUR.

The anti-diphtheria serum discovered by Prof. Roux, of the Pasteur Institute, is now being made up in the form of lozenges for use during convalescence. The profession had observed bacilli found in the mouths of patients several weeks after recovery were liable to convey the disease to others. The lozenges overcome this and also render preventive inoculation unnecessary.

BOOKBINDING.

The history of bookbinding chiefly concerns the ornamentation of the book, so we will devote our attention more particularly to the mechanical work of sewing and covering a book. A book is an aggregation of folded leaves called "signatures," the number of pages included in the signature varying according to the size of the page, as an 8vo, 16mo, etc. Folding is done by hand or by machine. The large daily newspapers have presses of which the folder is a component part. Many of the magazine and weekly presses are also equipped with folders. Every modern bindery uses mechanical folders, some of which are very large. One of our engravings represents a combined folding machine and wire stitcher which is automatically fed by a paper feeder.

Hand folding is used in some binderies for certain classes of work, as is also hand sewing. Most books are now sewed by machine, especially where there are several books of a kind, as an edition. One of our illustrations shows a battery of Smyth book-sewing machines. The work to be sewed is placed upon a table at the left hand of the operator. It feeds the signatures one at a time to the radial arms as they successively present themselves. The arm then makes a quarter revolution, and rises underneath a row of semicircular needles. These arms are provided with punches or perforators, which make a series of holes. The needles pass into and out of the holes thus made, carrying the threads through the back of the sheet and up through the hole close to the series of loopers, which hold open the loops from the transverse stitches so that the needles can pass through them. The loopers then retire, leaving their loops round the needles, and then come forward, taking new loops from the needles. The needles then withdraw, leaving these new loops round the loopers, and retire to their original position ready for the next signature. The sewn signatures are pushed back on a long horizontal table in one continuous book, which is separated into individual books by the cutting of certain threads. Each sewing stitch is interlocked upon itself, and is independent of every other stitch. Therefore, a book is held together until every stitch has been cut or broken. A product of 20,000 to 25,000 signatures per day can be gotten off the machines, while the average product of a hand-sewer is from 2,000 to 2,500; in other words, the machine does the work of eight to ten girls, and is one of the greatest labor-saving devices ever introduced into the printing trade.

Before sewing, the edges may be marbled or gilded. The edges of the book are covered with a size, the gold leaf is applied and allowed to dry thoroughly. It is then polished with an agate burnisher. The book is now consolidated by crushing in a "smasher." It is then taken to the rounding and backing machine, which is a new labor-saving device, doing away with much hand labor, and producing a uniform product. The edges are cut, before the book is rounded, by the aid of cutters, the construction of which is well known. The book is now ready for its case. Cases are made both by hand and machine. They consist of two mill-boards cut to size, covered with cloth, and the back lined with cloth. The Smyth case maker, shown in one of our engravings, employs only one operator and can make 500 cases per hour. The workman feeds a piece of cloth cut to the right size to the glue-applying roll. The machine automatically pushes two boards from the hoppers toward the center of the machine and a strip of back lining paper is trimmed down to

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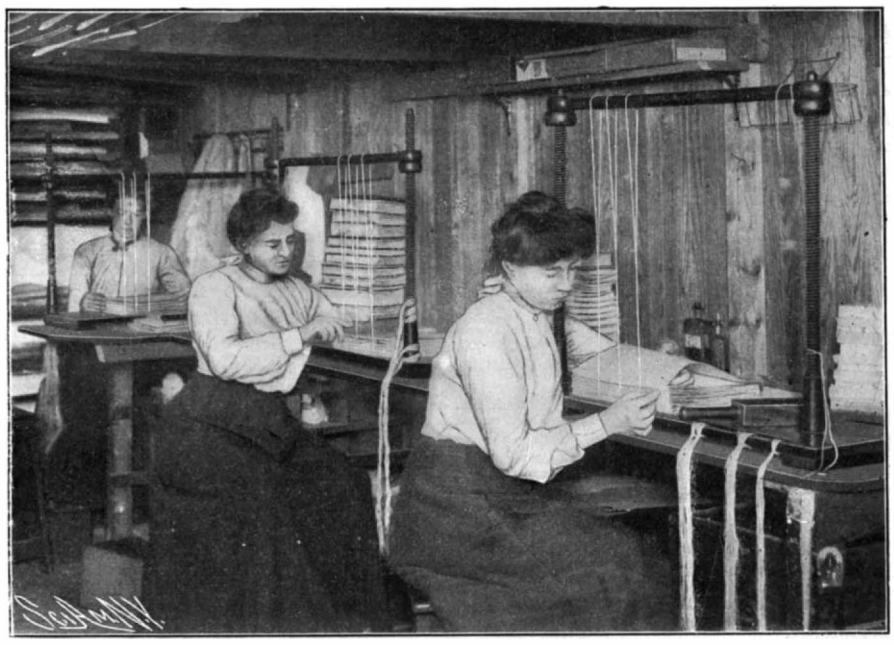
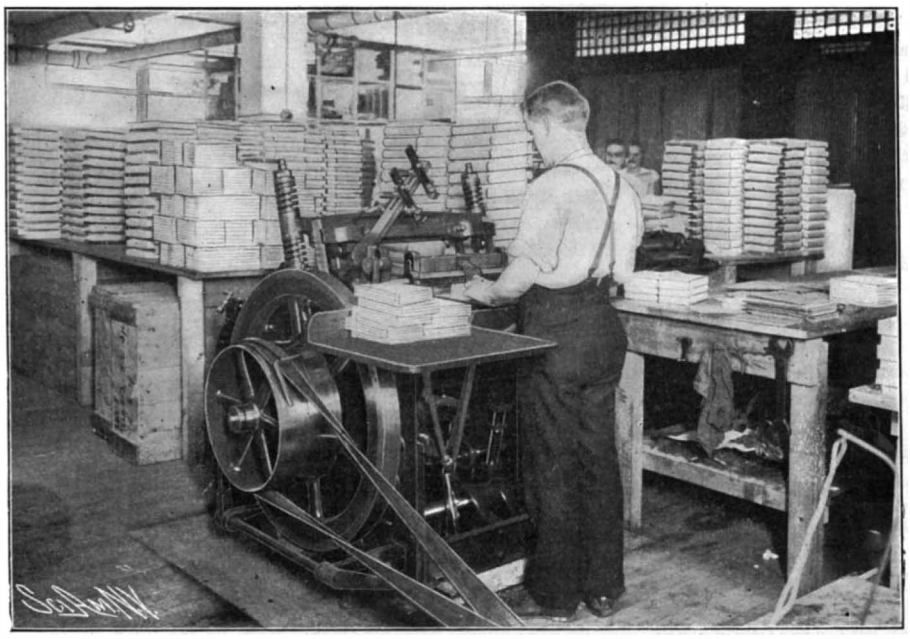
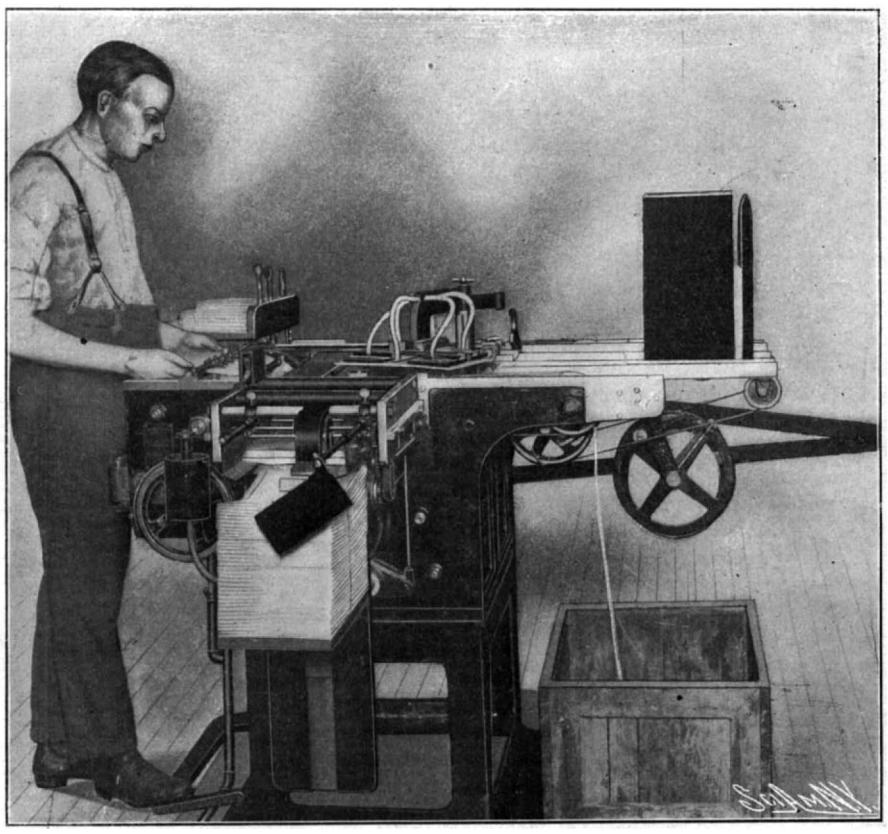


Hand Sewing.--Product, 2,000 Signatures a Day.

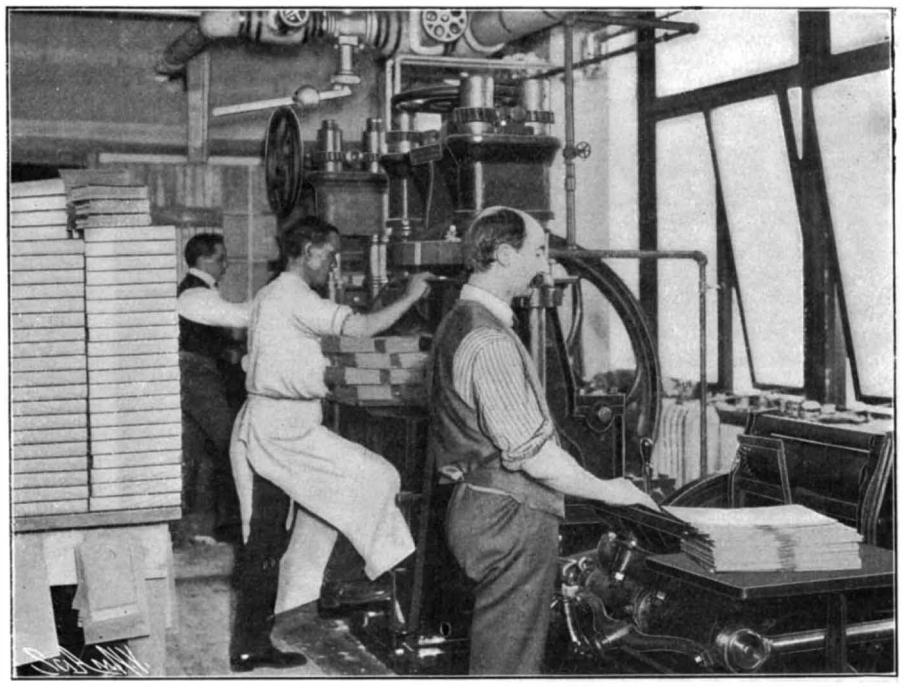
Sewing Machines.—Do the Work of Eight Girls Each.



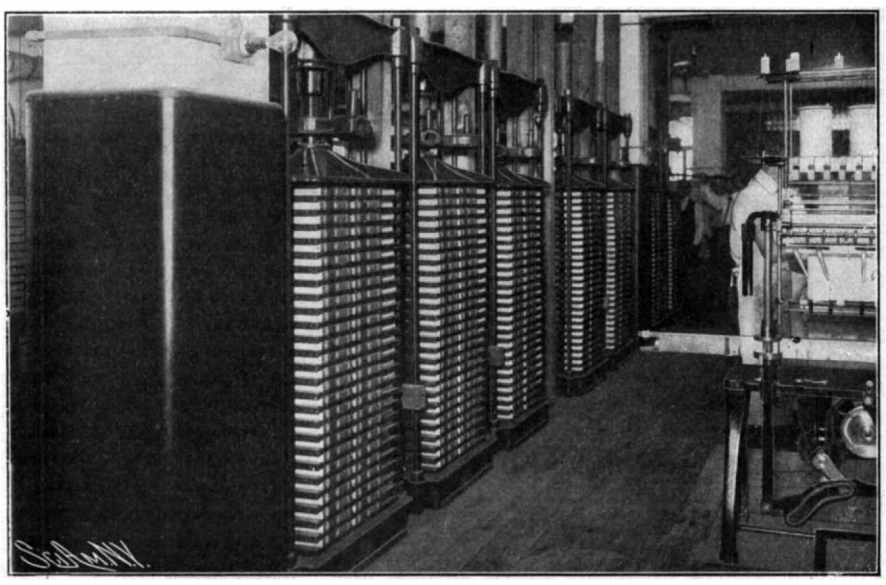
Rounding and Backing by Machine.



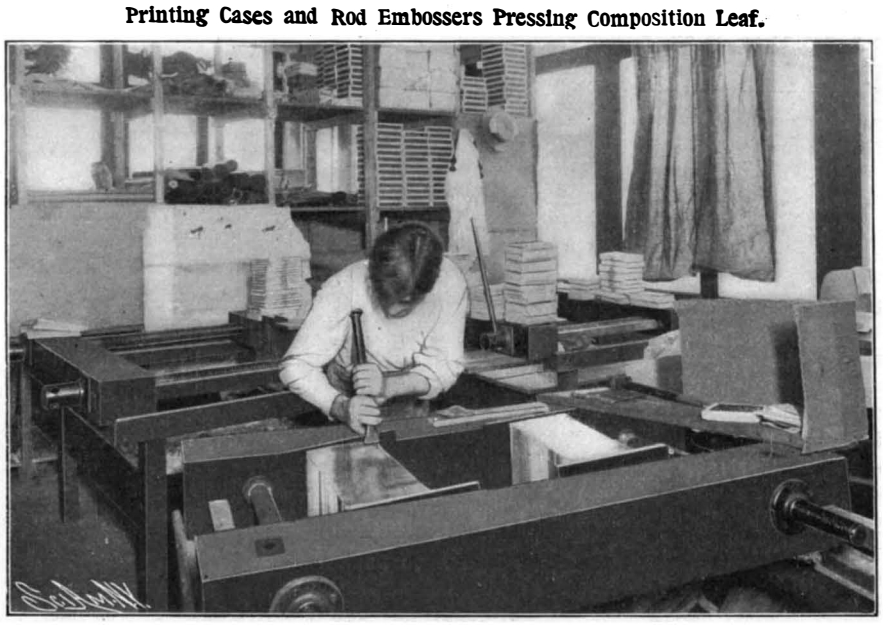
Making Cases by Machine.—500 Per Hour.



Printing Cases and Rod Embossers Pressing Composition Leaf.



Fourteen Hundred Books in Standing Presses.



Gilding Book Edges.

Hand-Finishing Fine Leather Work.

MODERN METHODS OF BOOKBINDING

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the correct width, is fed to the proper length, and is then cut off. The picker, through air suction attachment, descends under the two boards, and the back lining, and picks them up. While it is making a half revolution in a horizontal plane, the cloth carrier draws into the center of the machine a piece of cloth which has just been glued. A picker then descends and positions the two boards and back lining, and the glued cloth and folding bars are brought into operation, making the top and bottom folds first. A distributor then comes into operation, and moves the case into the press, shown to the left of the machine. The case dwells in this press during the whole time occupied in making the next case. It is then discharged upon the receiving table, shown at the extreme left of our engraving. The cases are now ready for embellishment, which may be in metal leaf or in colors. Gold or other metal leaf is applied to the cloth, and it is then embossed with a heated die in an embossing machine, and the surplus gold is rubbed off and saved. Ornamental designs are printed upon the cloth covers, usually by special presses built for the purpose which can also be used for embossing. A common form of embosser is shown in our engraving, and is what is known as a rod embosser. Composition leaf is growing in popularity among bookbinders, owing to the fact that it gives a very solid color, while in a case of printing it is sometimes necessary to run the case through two or three times. The embossing is done in the same way as with gold, and the surplus leaf is rubbed off. The case is now glued to the jacket, and the books are placed between the boards in what are called standing presses. Fourteen hundred books, all of one kind, are shown in the engraving. We are indebted to The Butler-Ward Company, New York city, for the interesting series of photographs which we publish relating to bookbinding.

Glass Making by Electricity.

It will be remembered that in the columns of a recent number of the SCIENTIFIC AMERICAN the Becker process of making glass by means of the electric furnace was very fully described. Since the appearance of that number of the SCIENTIFIC AMERICAN, a patent has been granted for an improvement in this process.

In melting the raw materials used in the manufacture of glass by means of the electric arc, difficulty is often experienced with the mixture, which consists of a powder, or is made up of numerous small particles. It happens that these small particles become agglomerated by partial fusion before arriving at the electrodes, so that it is necessary to assist the passage of the mass by pushing it from time to time. Consequently the mixture arrives intermittently between the electrodes, so that the latter, both as regards the thermic effect and as regards the mechanical wear by the friction of the raw material, are subject to varying stresses. Furthermore, the intermittent movement of the mass causes much carbon dust to fall from the electrodes, so that the glass becomes adulterated and must be carefully refined.

It has been ascertained by a number of experiments conducted by Jegor Bronn, of Cologne, Germany, that the disadvantages mentioned can be entirely avoided if the raw material be passed under or between the electrodes in the form of compressed rods, balls, briquettes or the like, or better still in the form of a continuous rod. This end can be attained by providing above the electric melting furnace an apparatus in which the raw material can be kneaded and compressed before it is allowed to pass between the electrodes. In order to assist the operation, water or any binding agent—water-glass for example—may be added to the raw material; or the calcspar commonly used in melting glass can be either wholly or partially displaced by strongly-binding hydraulic lime, plaster, or the like. For the purpose of producing a continuous rod, the raw material after being mixed with a suitable binding agent is preferably passed between rollers. By means of this apparatus the process can easily be carried out in such a manner that the variations of the electrical current are reduced to a minimum, and that the contact of the material with the electrode when heated by the circuit is entirely avoided. Hence the glass is purer in quality than heretofore.

A patent was recently granted to Napoleon R. Thibert, of Worcester, Mass., for a device which he thinks will eventually displace the carpenter's brace for boring holes. He has devised instead what he calls a bit rack, and the rotary movement is imparted to the cutting tool by means of a handle, which works in a horizontal guide and with a single pull. The bit is turned with a speed ten times greater than is possible to secure with the present tool. An attachment is provided, by which it is readily possible to reverse the direction of the bit. The advantage claimed is that there are many instances when the use of the brace and bit is impossible, or at least difficult, and with this improved tool a much greater latitude in work is permissible.

Correspondence.

The Inventor of the Telegraphone.

To the Editor of the SCIENTIFIC AMERICAN:

Will you kindly correct an error which crept into your admirable account, in the issue of the SCIENTIFIC AMERICAN of October 24, of a test of the National telegraphone on the Rome, Watertown & Ogdensburg division of the New York Central & Hudson River Railway?

At the request of the officers of the National Telegraphone Company, whose headquarters are in Rochester, I gave the appliance the crucial test which you so accurately describe. Truth demands the statement, however, that I am not so fortunate as to have been the inventor of the National telegraphone. My interest in it is purely scientific and technical.

The honor of the invention of the appliance belongs to Mr. Edwin D. Grauel, of Rochester.

Rochester, N. Y., October 23, 1903. JNO. DENNIS.

The Geysers of Yellowstone and New Zealand.

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN SUPPLEMENT for January 3, 1903, there is an article dealing with the geysers of Yellowstone Park, and reference is made to those in Iceland and New Zealand. It is stated that "while the geysers of Iceland and New Zealand are noted for their size and height, they are insignificant when contrasted with the Excelsior, Castle, and Giant. The Excelsior at times throws into the air a volume of water which is estimated to be from 50 to 60 feet in circumference and to often attain a height of 250 feet." The Waimangu geyser far exceeds in proportions anything described by Mr. Willey as occurring in Yellowstone Park. The writer has never seen Waimangu in action, but has often seen the Wairoa and Pohotu geysers, the former sometimes playing to a height of over 200 feet. I thought these particulars of the geysers might perhaps be of some interest to your readers.

J. A. RUDDICK,
Chief of Dairy Division,

Ottawa, Ont., October 20, 1903.

Draper's Specula Test.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to an article on "Testing Specula of Reflecting Telescopes," by Mr. James Alex. Smith, in SUPPLEMENT No. 1450, criticising and condemning the method of testing parabolic mirrors at the center of curvature, mentioned in my article in SUPPLEMENT No. 1306; allow me to point out that he is altogether in error, and has evidently never used the method referred to so adversely and unadvisedly. Indeed, he so entirely mistakes it as to prove that he does not even *understand* what he attempts to criticise.

Mr. Smith's error arises from the supposition that the very elegant test first devised by M. Foucault, and so successfuly used by Dr. Draper in the manufacture of his large photo-visual telescopes, is intended to measure the distance (aberration) between the radiant point z (in his—Mr. Smith's—diagram, page 23232) and the conjugate focal point x. He also wrongly states that the angle x, D, z is *bisected* by the *constant HD*; but let that pass, although it is not correct.

What the test is *intended* to do, and does do very accurately, is to measure the distances of xx', xx'', etc., representing the various focal points of the different zones of the reflecting surface of the mirror under examination. The radiant point z may vary considerably without affecting the value of the measurements.

The formula given by the late Dr. Draper is only a rule-of-thumb one, and of course is not mathematically correct; but unfortunately for the criticism of Mr. Smith, instead of being *deficient*, it gives a figure really a trifle in *excess* of the true aberration at the center of curvature, but for all the apertures ever found in practice, the error is so slight as to be quite unimportant.

I write this in the interest of your many readers, for should any one attempt to correct a speculum on the lines laid down by Mr. Smith, he would ruin it beyond recovery.

Had Dr. Draper corrected (?) his 15-inch specula by Mr. Smith's formula, he would have encountered a longitudinal aberration of nearly 3-10 of an inch and could have had no definition at all.

Camden, N. J. EDMUND M. TYDEMAN.

A Weakness in Modern Educational Methods.

To the Editor of the SCIENTIFIC AMERICAN:

As the apex of a pyramid is that point toward which all the lines of the pyramidal shaft converge and in which they center, so God is the climax truth toward which all lines of natural philosophy point and in which they culminate. As certainly as that the sun is the center and source of all our light, so certainly God is the center and source of all natural philosophy. As to follow any ray of light to its source will lead to the sun, so, likewise, to follow any natural philosophy to its conclusion will lead to God. He therefore who studies philosophy, or science, and stops short of God, philosophy, in his case, has utterly failed to answer the mission of its divine appointment.

Webster, the great statesman, well said, "No man can be a philosopher and deny the existence of God, for every step in the divine process goes to demonstrate the truth of the proposition he has denied." Look in what direction we may, we see the marks of fitness, adaptation, arrangement, and design, and if design there must be a designer. All philosophies, or the divine method of doing things, are but the footprints of creative energy which mark the Creator's everlasting going. These ceaseless and endless goings are uniform, if for no other reason than that man may follow on to know of the infinite intelligence and boundless benevolence of the Creator, and thus, too, to develop all the native faculties of the mind.

This suggests a new definition of the term "education." Were we to inquire of six intelligent men as to the meaning of this hackneyed phrase, we might have a half dozen different answers. Amid this confusion the student should closely examine the following definition of the word *education: It implies information, more or less, along all lines of useful knowledge, such as art, science, literature, sociology, good morals, and loving religion; and a corresponding development of all the native faculties of the mind, such as the intellectual, moral, social, and religious.* This definition of the word *education* seems to be the concession of all sound logic, of all sound philosophy.

Confronting this definition of the term education, what must we think of the modern state university which seeks to train only along *secular* lines, such as art, science, history, literature, and the like, giving little attention to the great science of social relation and the obligation of such relation, still less of the greater science of religion, which treats of man's relation to his Creator and the duty of such kinship, and absolutely nothing of the matchless science of God. The state university proposes to educate the intellect, largely to the neglect of man's social, moral, and religious nature. It is a proposition to educate the head to the almost utter neglect of the "heart, out of which are the issues of life." All this seems to be only unintentional blasphemy, and to unwittingly stop far short of the divine idea.

Recognizing the fact that a republic, to stand, must be based on the foundation of intelligence and virtue, it is marvelous that the state fails to see that to educate the head to the neglect of the heart is, to say the least, a very dangerous experiment. It ought to know that the more it puts in a man's head while his heart is wrong, the mightier engine it makes of him for evil. "Knowledge is power," simple power, serving alike in the hand of saint or sinner. Intellectual giants in all ages have gone up and down through the earth, seeking to destroy all that is beautiful of nature and lovely of virtue. The state should know that there is no necessary connection between the development of the intellect and that of man's higher and better nature. Such blindness to the possibilities of good citizenship and true manhood is the enigma of all enigmas. It is a misnomer to say that such a man is educated, when in point of fact he knows but little of the great science of good morals and a beautiful life, less still of the greater science of a religion of unity and of endless progress. Only one-half of the man, and that the poorest half, has been educated.

Not wonderful that the pulpit and the church have rushed to the rescue, and propose to educate the other and better half of man's nature, and thus allow the chariot wheels of civilization to roll on. The pity, shame, and disgrace, however, are that the pulpit and the church have been, and still are, largely handicapped by *sectism*, which seeks to give metes and bounds to honest religious thinking. They seem to forget what everybody knows, that "to think is to differ," and that the more we think the more we differ; while to love is to be united, and the more we love the more we are united. And the strangest thing of all is that these good people have failed to see that all human creeds are of the head, while true religion is of the heart.

The optimistic fact is, however, that little by little the ministry and the people are coming to read that "out of the heart," not the head, "are the issues of life;" that "with the heart," not the head, "man believeth unto righteousness;" that "Son, give me thy heart," not thy head, is the loving request of a benevolent Father. More and better, here and there colleges and universities are being founded in the spirit of liberty-loving America. They propose to educate along all lines of useful knowledge, and thus give a corresponding unfolding of all the native germs of the soul. Education with them means nothing less than humanity touched into manhood; they therefore teach a fellowship as broad as the love of God in Christ, and pray and work for a unified church and a saved race.

T. M. MCWHINNEY,
Chancellor Palmer University, Muncie, Ind.

New York, October 27, 1903.

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THE DUPLIGRAPH.

BY EMILE GUARINI.

The object of the Dupligraph, invented by a young Canadian, of Montreal, at present engineer of the Addressograph, Limited, of London, is the printing of letters in imitation of those written by the typewriter, the address of the person to whom the letter is to be sent changing automatically in each, and the signature of the sender placing itself, or not, at the end of the document, and the whole in one operation.

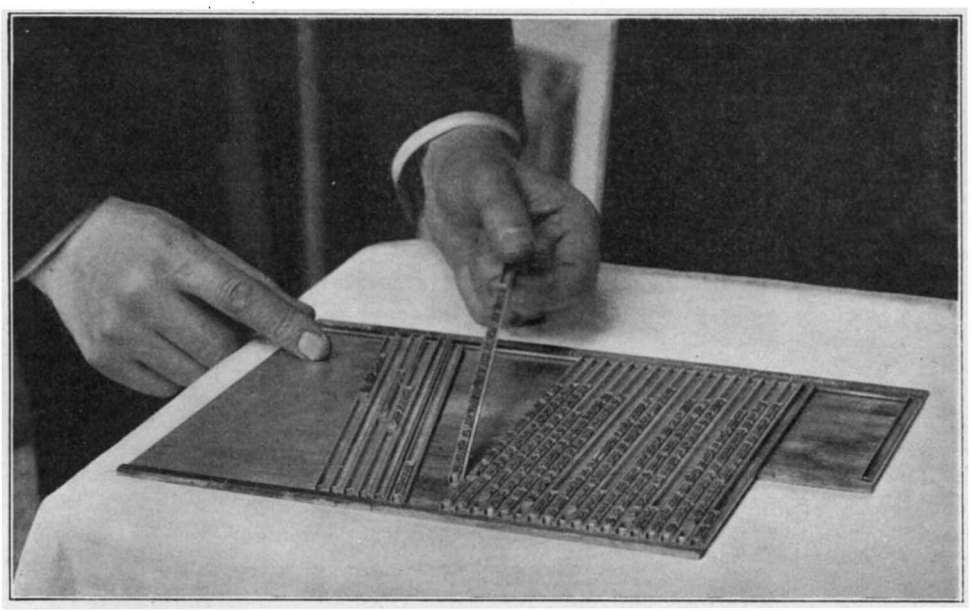
The parts employed for the printing include a chase containing the body of the letter, a belt carrying the addresses and the word "Mr.," "Messrs.," "Mrs.," etc., and finally the signature, which is placed mechanically after the chase is raised. The signature may, if desired, be printed with a different ink, and be autographic, or not, or be omitted altogether.

The addresses, which correspond perfectly with the body of the text, since they are printed at the same time and inked with the same roller, are united upon the belt of an Addressograph, a machine well known in America. Upon leaving the machine, the letter is therefore complete. It is possible for each Dupligraph to print 1,000 letters an hour.

We shall not enter into a more detailed description of the machine, since the accompanying engravings show its construction and operation sufficiently well. The lines of types are placed in and removed from the form without any trouble and this permits of rapidly preparing several forms. The form necessitates no other operation for being printed from than that of being slid under the inking rollers, because it fits exactly into the space designed for it. The signature slides in the same way into its support, which may be raised or lowered according to the length of the letter. As for the band of addresses, that is placed upon a channeled and polygonal roller that automatically causes the advance of a new address after each letter has been printed. The mechanism is actuated by an electric motor placed in the foot of the apparatus.

Contrary to what might be thought, at first, the Dupligraph is not a machine designed for printing-offices, but for commercial houses. It does not necessitate the intervention of a professional typographer, and the modifications to be introduced into the text necessitate no tools nor manual dexterity. The inking is done by special rollers that do away with the inconveniences inherent to inking in the ordinary manner. The corrections and modifications of the text can be effected in a few instants.

The Dupligraph can be used for printing not only circular letters, but also price-lists, memoranda, sheets of instructions, lists, etc. It seems to be particularly well adapted for the production of prices current, owing to the facility that it presents for the revision and correction of figures when changes occur in the market prices of merchandise.



Putting the Type in the Form.

Upon the whole, the apparatus seems to be destined to render great services in the wholesale trade, and, in general, wherever modifications have to be made in certain parts after each sheet is printed. The use of the Dupligraph can therefore result only in a saving of time and labor, and consequently of money.

The house in which the American flag was born will be reproduced by the Betsy Ross Memorial Association. The original house stands in Philadelphia.

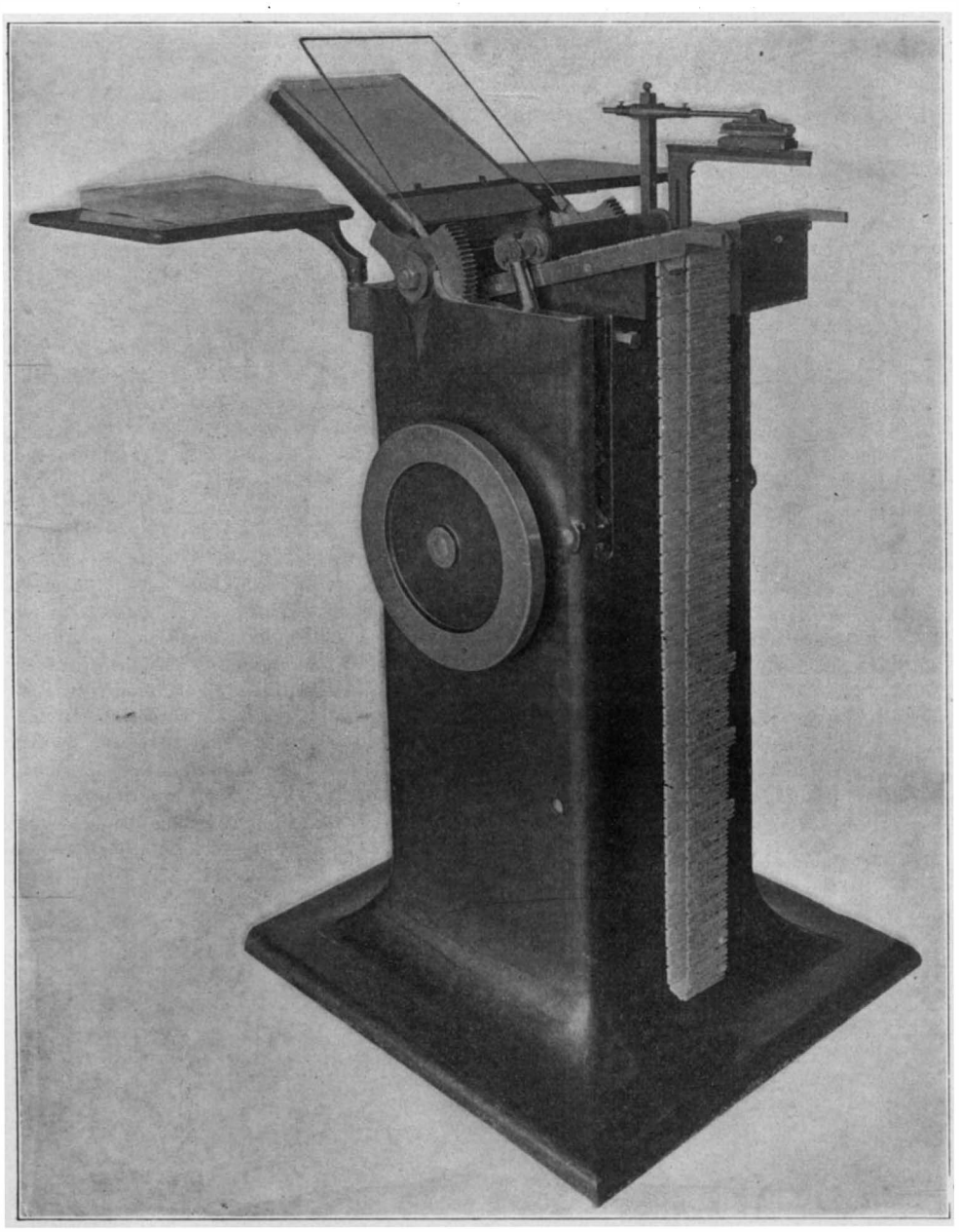
THREE-COLOR PROCESS.

The attempt to print in colors from half-tone plates by means of photographic processes was partially solved by Frederick Ives, of Philadelphia, in 1888. Since that date the process has been improved with gratifying results. The principle upon which it is based is that by a combination of the three primary colors—red, yellow, and blue—almost any shade of color can be produced. Photographic plates that are specially sensitive to color are used. As in the half-tone process, a glass screen is placed in the camera. Three photographic negatives, each of which is to produce a separate printing plate, are made of the object. In each case a colored glass screen, excluding certain color rays of light, is used in front of the lens. In the production of the plate which is to print the blue ink, a red color screen is employed; to produce the plate for yellow ink, a blue-violet screen is used; and to produce the plate which is to print red ink, a green screen is used.

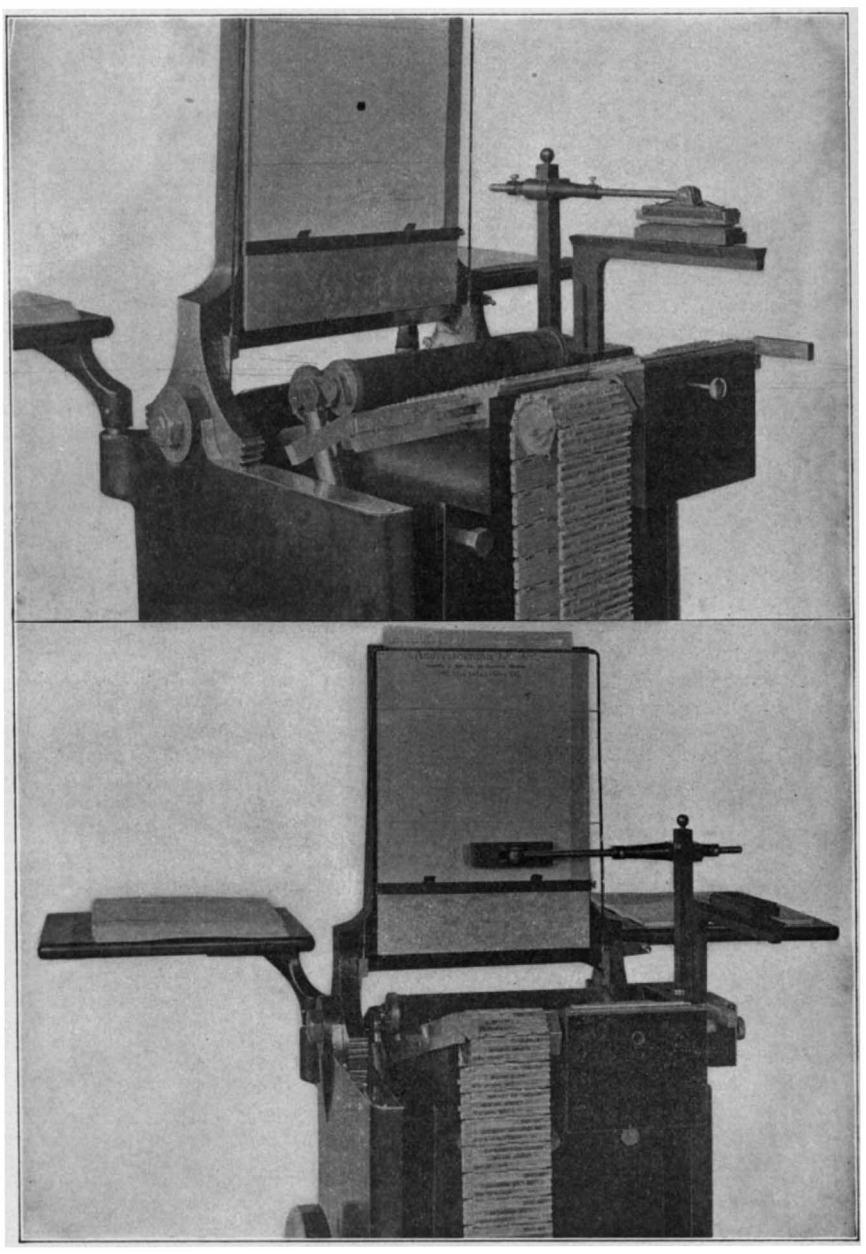
In printing from these plates great exactness, technically called "register," is required, in order that the colors may be laid on in proper place as the three impressions are consecutively made.

One serious problem which confronted the inventor was the difficulty experienced in so arranging the line screens that the diagonal lines would not form geometric patterns in the finished picture. This was solved by the discovery that by varying in certain ways the direction of the lines used for the three negatives, the pattern effect could be avoided.

After prolonged tests on the Invalides-Versailles portion of its system the Western Railway Company of France has decided to heat several corridor trains electrically. Each carriage is to be fitted with ten brass foot-warmers, arranged in two groups of five each. These are connected in series across the 550-600-volt supply. Each foot-warmer is 80 centimeters long and 14 centimeters broad. The current consumption per carriage—i. e., for every ten foot-warmers—is stated to be 1,100 watts.



Front View of the Dupligraph.



Inking the Signature Stamp.
Taking an Impression of a Signature.

THE "DUPLIGRAPH."—A DEVICE FOR PRINTING FAC-SIMILE LETTERS, INSERTING NAMES, ADDRESS AND A SIGNATURE.

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NEW YORK, SATURDAY, NOVEMBER 14, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SCIENTIFIC AMERICAN AND THE SUPPLEMENT.

WE have received a letter from a subscriber to the SCIENTIFIC AMERICAN who complains of the fact that occasionally, after having his interest aroused in some article published in the parent paper, he finds himself referred to the SUPPLEMENT for fuller details; and although no specific request is made that the SCIENTIFIC AMERICAN and the SUPPLEMENT shall be thrown into one, the context makes it clear that this is the thought that is in his mind. The criticism is frank and evidently friendly, for in his opening sentence the writer says: "I think your journal the best of its kind ever published, and I have been a subscriber for over twenty years, in which time I have induced a number of friends to become readers of your paper." It is possible that other readers of our journal may have asked themselves the same question as our correspondent, and in explanation of the course that we follow, if any should be thought necessary, we offer the following considerations:

It will be generally conceded that the SCIENTIFIC AMERICAN holds a unique position among the scientific publications of the day. When the enterprise was started, now over half a century ago, it was realized that there was a call for a scientific publication of a more popular character than those which were devoted to special branches of science and industry, and were written for purely professional people; and it was the belief of the original founders of the paper that it would be possible to offer to the public, week by week, a digest and discussion of the current happenings in the scientific world which, while it was so thoroughly accurate and reliable as to command the interest and attention of those readers of scientific literature whose theoretical knowledge and practical skill placed them in the very front rank, should yet be so carefully edited, and the matter presented so judiciously selected, as to render it intelligible and useful to that great majority of the American public who have neither the opportunity nor the means to devote more than a limited time to keeping abreast of the world's industrial progress.

It will be realized at once that to conduct a scientific journal successfully upon these lines, and at the same time keep it within reasonable dimensions, called for a very careful selection of material and involved, necessarily, the rejection of a large amount of current literature which was of too special a nature to warrant its insertion within the covers of a popular scientific journal of the kind proposed. In the first twenty or thirty years of the paper's existence, when the field of science, mechanics, and engineering was far more limited than it is to-day, it was possible to include in the paper a large amount of scientific information and literature which, as the field broadened, the number of learned societies multiplied, and the outflow of lectures, treatises, and papers grew to its present dimensions, it was absolutely impossible to publish except in a form so abbreviated that the value of the matter would be practically lost. In order to meet the difficulty it was decided to publish an overflow journal, which should appear contemporaneously with the parent paper. From the time of its very first issue, the venture has proved to be a very successful solution of the problem. The circulation has increased to a volume which proves the wisdom of the policy adopted, and it is a fact that nearly the whole of the subscribers to the SUPPLEMENT are also subscribers to the SCIENTIFIC AMERICAN. Not only has the publication of the SUPPLEMENT served to take care of the overflow, which includes some of the choicest scientific and technical literature of the day, but, by excluding a large amount of matter which, in its very nature, was too abstruse or too special for a large class of our readers, it has enabled the editors to include in the SCIENTIFIC AMERICAN a larger amount of that more popular technical literature that has served to bring the paper to its present standing.

In order to enable all the readers of the SCIENTIFIC AMERICAN to take the weekly SUPPLEMENT also, a combination rate has been arranged by which the subscribers receive a larger amount of technical literature than is offered for the same consideration by any of our contemporaries at home or abroad. We do not hesitate to challenge comparison on this score with any of the better-known foreign technical journals; and if any reader wishes to estimate on the basis of amount received for a given subscription, he will find that the SCIENTIFIC AMERICAN and the SUPPLEMENT together contain as much reading matter as is offered for the same sum by any other technical journal. As to the matter of cross reference from the SCIENTIFIC AMERICAN to the SUPPLEMENT, we can only say that it follows naturally from the very necessities of the case that have led us to the publication of two separate journals instead of combining them in one. Thus, in the case of some epoch-marking discovery, such as that of X-rays or of radium, it invariably happens that the first authentic announcement comes in the form of a profoundly philosophical or technical paper read by the discoverer before some learned society. In such a case, it is our custom to present an editorial review of the subject, in which the essential features of the invention or discovery are described, and a brief digest of the paper itself is given. At the same time, there will be a considerable portion of the reading public that will wish to read the paper itself, and accordingly the latter is published in the current issue of the SUPPLEMENT, a cross reference to the same being made for the guidance of the reader. The policy has worked so well, and has proved so acceptable to our readers, that we feel satisfied that we shall be justified in its continuance.

DELAY IN THE CONSTRUCTION OF NAVAL SHIPS.

The dominant note in the annual report of Rear-Admiral Francis T. Bowles, Chief of the Bureau of Construction and Repair, whose recent resignation from the navy we must all greatly deplore, is one of regret at the continued existence of the trouble which has always hampered the great work of building up the new navy of the United States, namely, the extreme slowness of construction. To the average citizen, whose mind is just now impressed with the absolutely chaotic condition of things in the shipbuilding industry, it will not be surprising to learn that the new warships that are under contract to be built in private yards are from twelve to fifty-three months behind the contract date of completion. On the other hand, the delay antedates, in some cases by several years, the period of wild-cat speculation and most questionable stock jobbing which is chiefly responsible for the present shipbuilding troubles. Thus, in the case of the torpedo-boat destroyers, six of which are from four to four and a half years behind, the delay is to be attributed chiefly to the inexperience of our shipbuilding firms in the difficult construction of these delicate vessels. Many months ago the Bureau of Construction, realizing the impossibility of the boats being brought up to contract requirements as to speed, suggested that the standard of speed for acceptance be lowered; but judging from the fact that there are a half dozen of these boats still on the builders' hands, it is evident that the failure is even more complete than was suggested. It is not only the torpedo boats that are badly behind time; for the "Ohio," a sister ship to the "Maine," is now thirty-three months behind the contract time, and will probably not be completed until the early summer next year, while the sister ship "Missouri" is about two years behind time. The five vessels of the "Georgia" class are from fifteen to eighteen months behind time, and we hear the same discouraging story as regards the other class of vessels. Armored cruisers are delayed from five to nineteen and a half months, and protected cruisers from twelve to twenty-one months behind time. Just here it should be noted that of all the battleships that are under construction, the only one which is not seriously behind time is the "Louisiana," now building at Newport News. The significance of this exception lies in the fact that the sister vessel, the "Connecticut," is now being constructed at the New York navy yard; and while it is not officially acknowledged that there is any competition between the government-built and the private-contract ships, the public will surely be justified in drawing the conclusion that the building of ships in government yards has a very material stimulating effect upon private contractors. Years ago we supported the late Admiral Bowles in his contention that government-yard construction would serve as a great stimulus to private contractors, and we believe that had the practice been in force at the time the present contracts were given out, there would have been no such delinquent list as now disfigures the annual naval report.

DEATH OF PROF. MOMMSEN.

Germany's famous historian, Prof. Theodor Mommsen, died on November 1. Prof. Mommsen had a varied and interesting career. He was born at Garding, Schleswig, November 30, 1817, and received his early education from his father, a Protestant clergyman. After the usual course at the Gymnasium, he studied at the University of Kiel. Whatever poetic aspirations Mommsen may have had in his youth were nipped in the bud, for a book of verse which he brought out with his brother, Tycho, received the general condemnation of the reviewers. At the age of twenty-five Prof. Mommsen was made a doctor of philosophy. The following year saw the publication of his "De Collegiis et Sodalitiis Romanorum," which began his career as a historian. The book was characterized by a certain grace of expression that had not theretofore been encountered in German histories. The same characteristics are to be found in his later works and soon established his reputation. Later his historical work became infused with a certain bitter irony that enlivened many a dry page of historical narrative. From history he branched out into politics and became a radical propagandist for constitutional progress. Such was the violence of his attacks against the prevailing order of things that the government found it necessary to arrest him. He was acquitted eventually by the courts; but he lost his professorship.

A man of Mommsen's remarkable ability was not long idle. He received a call from the faculty of law at Zürich. It was in Switzerland that he began his history of Rome. In 1854 he was appointed professor of Roman law at Breslau. Four years later he was called to the University of Berlin. Mommsen was one of Bismarck's bitterest enemies. He attacked the "Iron Chancellor" time and time again in speeches which, in the eyes even of his friends, sometimes overstepped the bounds of professorial dignity. He characterized Bismarck's tariff policy as a pure swindle. To defy Bismarck was serious enough; to call him a swindler was hardly to go unpunished. Naturally enough Mommsen was arrested and tried for slander. The courts, after a hard fight, decided in his favor. It was one of the great triumphs of his life.

Mommsen's characteristics as a historian, as we have pointed out, are above all his lucidity of style and his wonderful thoroughness. Throughout his whole life he remained a student, always unearthing new things, always learning. Often enough students who had gathered at Berlin to listen to his lectures were doomed to disappointment; for the long-faced, lean old historian had gone off to Italy to gather more material about Rome. Fifteen years ago a complete list of his writings occupied some sixty closely printed pages. As the historian kept at his literary work after that time, the bibliography of his works has assumed even larger proportions. Something of the esteem and respect in which he was held by scholars throughout the world was evinced in 1880. In that year part of his library was destroyed by fire. From all parts of the world scholars sent contributions to replenish the collection.

ON THE THEORY OF THE CRITICAL STATE.

Some facts observed by De Heen, Galitzine, Batelli, and others are at variance with Andrew's theory of the critical state. De Heen has, e. g., shown variations in the density up to 100 per cent to be present in the same tube, above the critical temperature and at constant temperature and pressure. As, however, the experimental conditions under which the densities were determined are somewhat doubtful, it was interesting to test these results by a new method free from such uncertainties, this method consisting in determining the density both below and above the critical temperature by means of small glass balloons ascending inside of the tube in question. Similar experiments, as recorded in a paper read at a recent meeting of the German Physical Society, were carried out by J. Traube and H. Teichner, a complete scale of small glass balloons of different densities being prepared. The densities of the balloons were determined by ascertaining the temperature at which the balloon would become suspended in heated ether. Experiments showed that the balloons, as far as 10 deg. above the critical temperature, would be kept for hours in suspension at different heights, corresponding with their density and that of the surrounding medium, thus indicating differences in the density as high as 50 per cent and more, though a perfect equilibrium both of pressure and temperature be prevalent. Evidence was thus shown of the incorrectness of Andrew's theory, as in accord with De Heen's experiments different densities may coexist at the same pressure. Two different matters must accordingly coexist at the critical temperature, one being liquid and one gaseous, the critical temperature having to be considered as the point at which both matters are miscible in any ratio, whereas a partial miscibility has been observed at temperatures far below the critical point.

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A GRAPHICAL COMPARISON OF RAW AND FINISHED PRODUCTS IN THE PRINTING AND PAPER-MAKING TRADES.

When figures get beyond a certain point they lose their concrete value, and it is necessary to resort to some other means if we wish to make comparisons involving figures that run up into millions and billions. Therefore, we adopt the method of representing these figures by comparisons of bulk and form. The basis for the comparison which we have worked out is the Twelfth Census of the United States. In the opening article of this issue, devoted to the "Economic Side of the Industry," we have given a considerable number of the figures which are here also used.

The manufactures of paper and wood pulp have become so closely related that they are now usually treated as a single industry. Over 1,986,000 cords of wood were used in 1900 in the production of paper pulp. This would make a cube 634 feet high, and is a pretty large wood pile when compared with Trinity Church, New York. Straw comes next, 367,305 tons being consumed annually, and making a pile of bales 607 by 405 by 270 feet. We have not considered the subject of chemical fiber, owing to the diverse forms in which it is consumed, although the bulk is very great, amounting to 644,006 tons. The old or waste paper consumed amounted to 356,193 tons. This would make a solid 499 x 348 x 254 feet. Two hundred and thirty-four thousand five hundred and fourteen tons of rags were consumed; this would make a pile of bales 436 x 284 x 207 feet. Ninety-nine thousand three hundred and one tons of Manila stock, including jute bagging, was also used.

Now, having dealt with the vast proportions of the raw materials, we come to the finished products. Our comparisons show "news" paper in two forms: first, in the roll, 454,572 tons making a roll 450 feet long and 225 feet in diameter. News papers in sheets amounted to 114,640 tons and the flat packages in which it is put up would measure 484 x 187 x 33½ feet; this pile is compared with the World Building, New York.

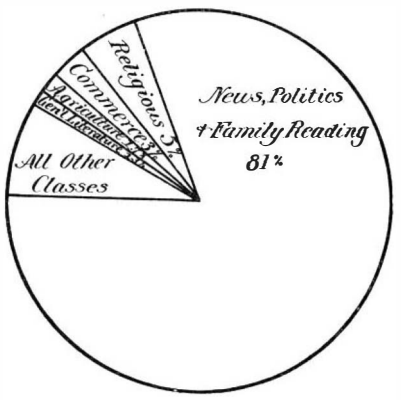
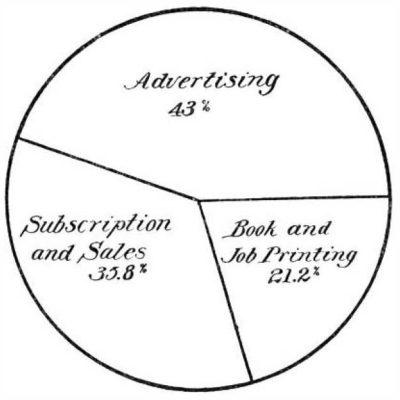


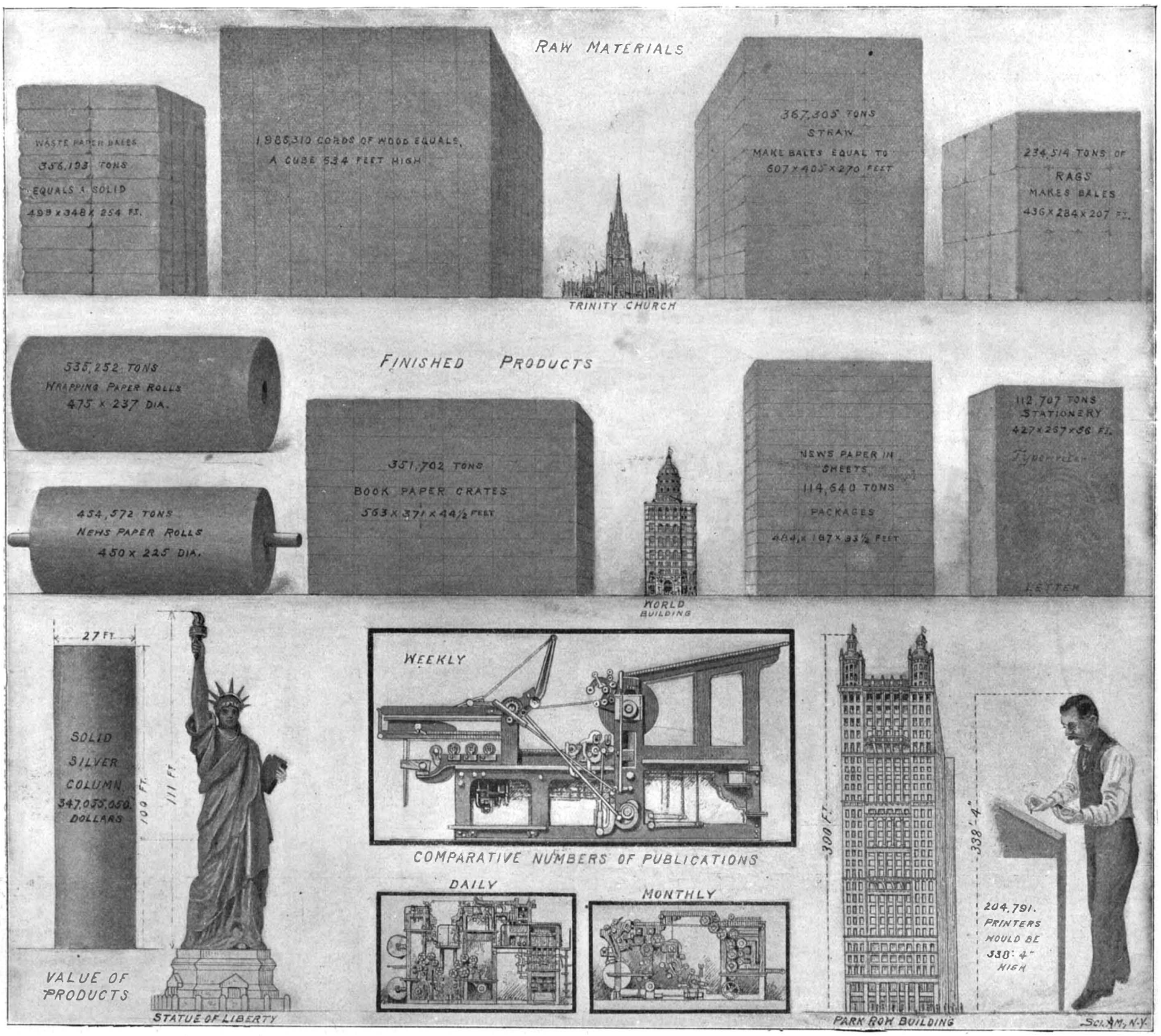
Diagram Showing Classification of Papers.



Proportion in Which Advertising, Subscription and Sales and Book and Job Printing Form of the Total Value of all Products.

with printing presses denote the relative number of periodicals of various kinds. Thus the square marked "Monthly" stands for 1,817 periodicals; the "Daily" stands for 2,226 periodicals; and the "Weekly," 12,979 publications. To print the finished product requires the services of 204,791 printers. If they were combined to make one man, he would be a Colossus 338 feet 4 inches high, and would reach well up toward the top of the Park Row Building. The value of printing products, excluding the value of the paper and pulp product, which amounts to $127,326,162, is $347,055,050, which would make a solid silver column 100 feet high and 27 feet in diameter. This is compared with the Statue of Liberty. We feel that the presentation of these enormous figures graphically will prove interesting to many of our readers.

One lesson of the recent disaster on the Paris Metropolitan Railway is to emphasize the importance of a special fire helmet for irrespirable atmospheres. It seems that a helmet of the kind has been designed, and the Paris Municipal Council have voted $600 for the manufacture and experimental use of a number of helmets in the principal stations. The helmet consists of a glazed circular headpiece surmounted by a small chamber containing an air pump, a visor to protect the face, and with the air pump are connected two tubes—one for inspiration and the other for expiration, and merging in an India-rubber pipe connected with an air compressor near the spot to be explored. Three men are necessary, one to penetrate into the choke area, the other to hold a safety lamp, and the other to work the air compressor.



AMOUNT OF MATERIAL CONSUMED ANNUALLY IN THE MANUFACTURE OF BOOKS AND PERIODICALS IN THE UNITED STATES.

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SOME OF OUR COMMON SNAKES.—I.

BY ARTHUR RUSMISELLE MILLER SPAID.
PHOTOGRAPHS FROM NATURE BY THE AUTHOR.

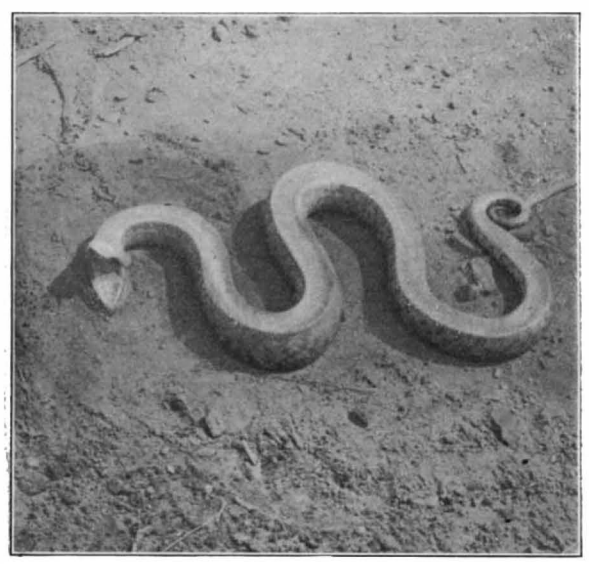
NO where one may, one finds a universal horror of snakes among all classes of people, yet there are fourteen harmless to one venomous reptile in the one hundred species in America, and of this number there are not over twenty-five species, perhaps, to be found north of Virginia and east of the Mississippi. Among these, unfortunately, are the rattlesnake and copperhead, two dangerous representatives of the pit vipers. No family, however, has suffered more than the ophidians on account of the sins of the few. Consequently, we find the "seed of the woman" crushing the heads of serpents as if it were a religious duty, regardless of the fact that many snakes are not only harmless, but useful.

To make a study of snakes it is necessary to have them in one's possession, and those who are familiar with the various species can secure the non-venomous without any trouble or danger by seizing the reptile back of the head with the thumb and forefinger, holding the other fingers in reserve to press upon the victim's throat, should it struggle to free itself; and if it does succeed in slipping from the grasp, it is too much frightened usually to think of biting. But no one should attempt to catch venomous reptiles in this manner; with them, strong, quick, and enraged by being disturbed, no chances should be taken. For their capture the snare should be employed. Indeed, it is advisable to use the snare in handling all snakes. Its construction is very simple. In the end of a stick (an old broom handle will do) drive a double-pointed tack or small staple partly in; to this fasten a thong about one-fourth of an inch wide and long enough to reach up to the hand, and pass the loose end under another staple similarly driven in the side of the stick two or three inches from the lower end. Between the two fastenings the thong can be pulled out, making a noose of any size, which, when slipped over the head of a snake, makes it a prisoner by a quick pull on the string. Even a large banded rattlesnake soon submits to this choking process, but not until it has erected its fangs in a vain attempt to bite and has made a vigorous effort to free itself from the toils of the snare.

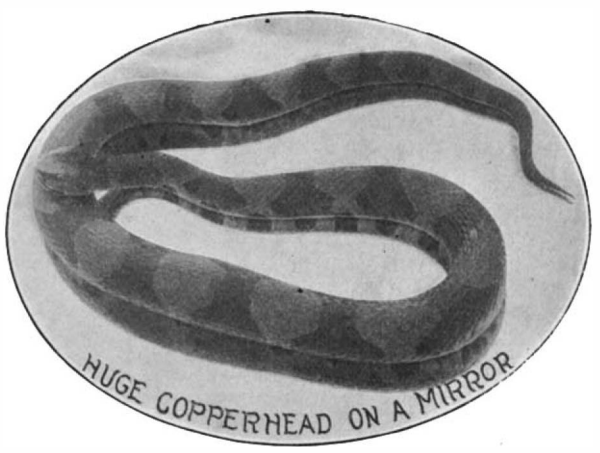
Photographing reptiles is a most fascinating and profitable study to anyone who wishes to know the life histories of these interesting and much maligned animals, although one has to work hard to secure specimens. Snakes are retiring in disposition, a few appearing to be somewhat nocturnal in their habits, and on account of man's enmity and persecution are no longer numerous in most localities. Fortunately specimens can be kept in captivity without much trouble for weeks, during which time valuable observations may be noted and photographs made under the most favorable conditions.

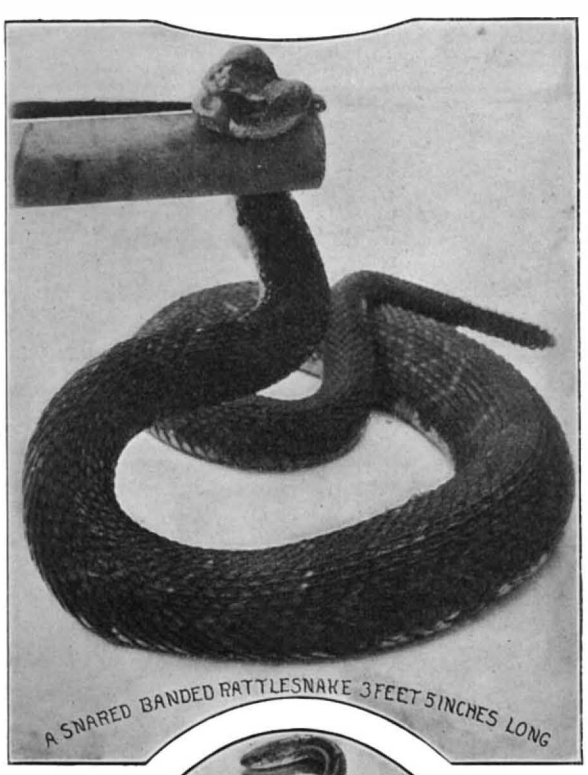
The pit vipers are good subjects to photograph. When either the rattlesnake or copperhead assumes the defensive (and that is the attitude of both usually) there is no danger of a movement of a single muscle on their part while the plate is being exposed. Not so with the other ophidians, except perhaps in the case of the blacksnakes, and they will try to escape oftener than stand their ground when placed in front of the camera. Almost any snake, however, can be induced to assume an attitude of defense (its most interesting position) or can be so completely cowed by switching it around the neck every time it attempts to run away that the most active specimen will permit itself to be placed in any position. I discovered, however, in taking pictures of snakes that a dog is well nigh indispensable. Every snake seems to recognize the dog as a dangerous assailant, and when thus attacked almost invariably assumes the defensive. Some dogs will attack and kill the largest snakes without hesitation, while the majority are either so afraid of reptiles as to keep away from them altogether, or satisfy themselves by baying at them from a safe distance. They kill them by seizing the serpent in the middle and shaking it so violently as to frequently jerk it to pieces. The black-and-tan dog that I had was too small to kill a large snake, but she would attack it when urged on.

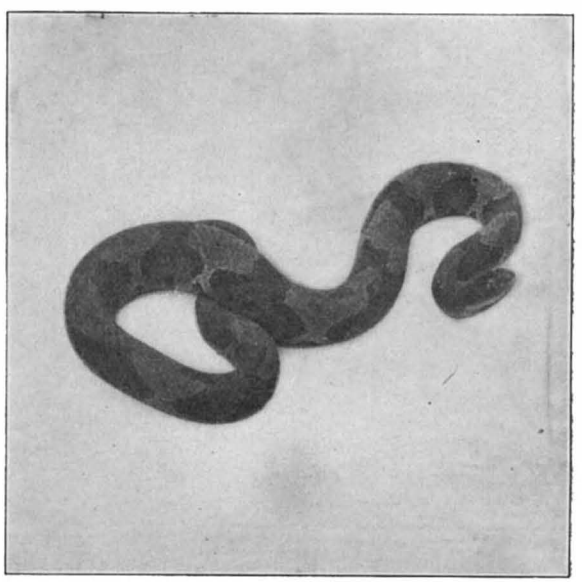
Some snakes which have peculiar markings either low down on the sides or beneath can be photographed on a large mirror to advantage. The spots which would not otherwise show can be seen by the reflection in the mirror. It also affords an excellent opportunity



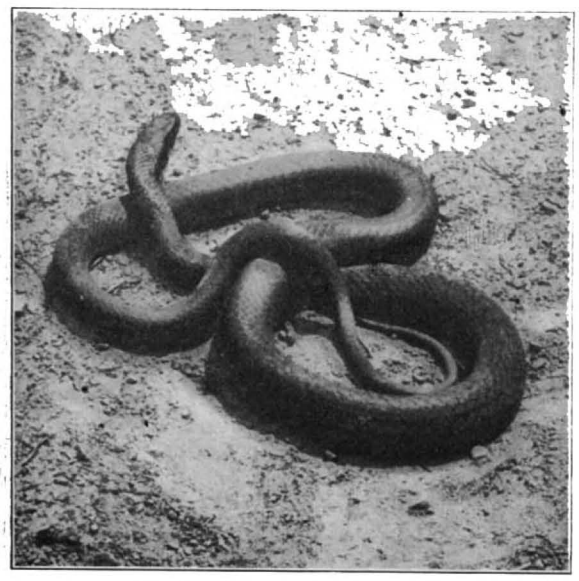
A Hog-Nose Snake.





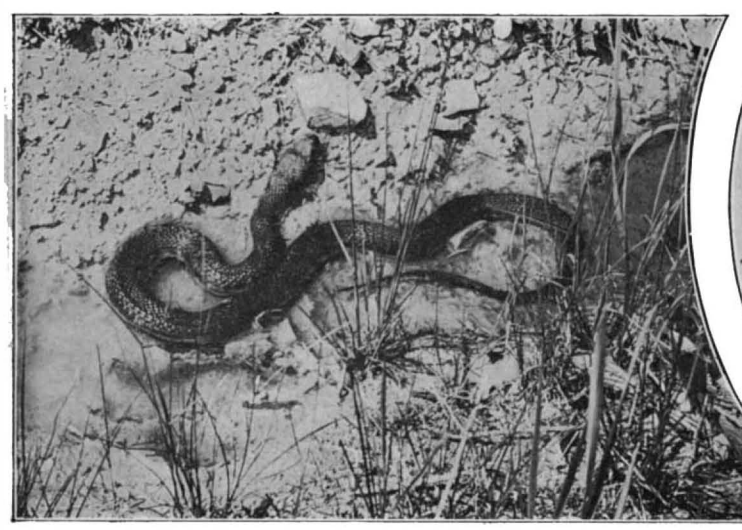


Copperhead on the Defensive.

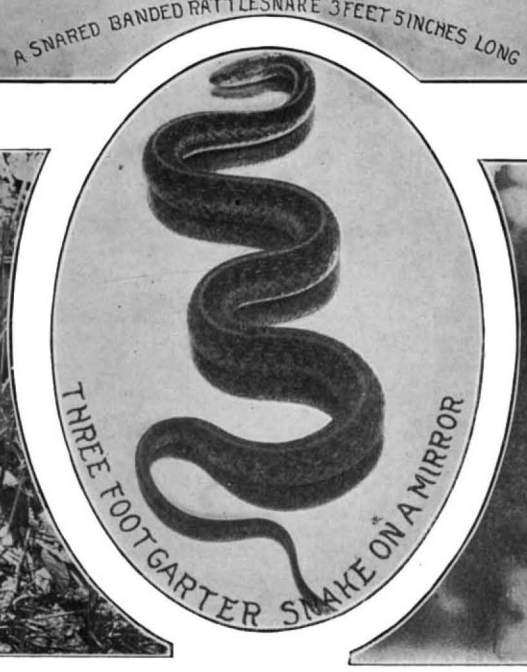


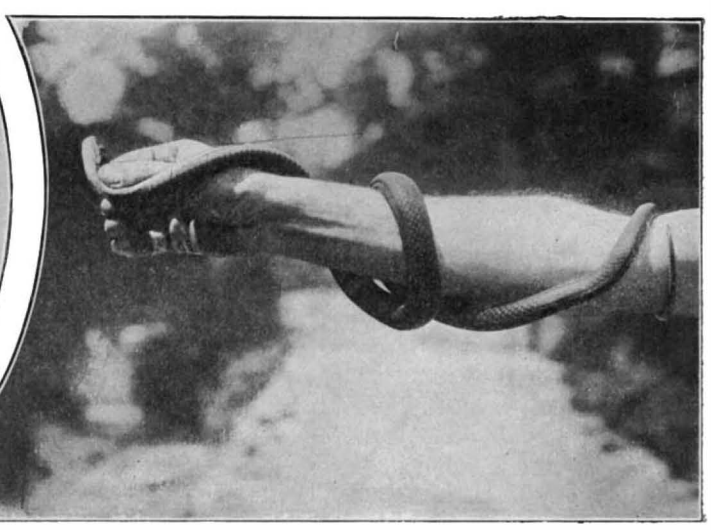
Blacksnake Completely Cowed.

Ribbonsnake.



Watersnake 2 feet 7 inches Long.





Blacksnake 3 feet 10 inches Long.

SOME OF OUR COMMON SNAKES.

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to disprove the statement so often made that snakes cannot crawl on a smooth surface, such as a table or dish. The mirror does retard crawling, but it by no means wholly prevents locomotion.

The common water snake or water adder is the most numerous of our non-venomous reptiles and the least desirable on account of its destruction of small fish. Simulating an old stick it lies in wait among the aquatic plants for the minnows and other small fish that seek the shallows of creeks and rivers to feed where they will not be molested by the larger fish, only to be caught by the voracious water adder. It sometimes seizes a fish too large to swallow, but by perseverance it drags the struggling victim into shallow water or drowns it, when it sets about to eat a square meal. One evening as I was crossing a stream I saw a black bass at least six inches long floating by with a water snake not more than two feet in length holding it by the lower lip. As the bass appeared to be dead, I jumped into the water to get it. At my approach the snake attempted to drag its victim back into deep water, but as I gained on it the adder let go reluctantly and the fish swam away as lively as ever. The water snake enjoys a sunbath on the bank of a stream, on the branches of the bushes overhanging the water, or on a pile of drift. At the approach of anyone it glides swiftly into the water and hides beneath the bank or under the drifts. It is a graceful and rapid swimmer, but there is nothing attractive about its color nor interesting about its habits. It bites viciously, but there is, of course, no venom.

We have another snake which is generally found near water, to which it takes when alarmed. It is the pretty ribbon snake, the most delicate and beautiful of our serpentine family. It prefers the banks of secluded streams, where it basks in the sunshine on some large stone, displaying its three narrow stripes of gold and two broad ones of light brown. The eyes are large. Its disposition is gentle, the little creature seldom attempting to bite. It also possesses great elegance of form. A specimen I had measured two feet one inch in length and weighed only five-eighths of an ounce!

The common garter snake, to which the ribbon snake is related, is very widely distributed and is easily distinguished from other species of our common snakes by the yellowish dorsal stripe extending from head to tail along the back. It also is found frequently in localities bordering streams, where it goes to slake its thirst or catch frogs. A large specimen three feet long which I had in captivity ate in one night a mouse, a large toad, and three tree-toads, but fasted for six weeks thereafter. At times, however, it drank copiously. This leads me to say that snakes undoubtedly drink more water than is generally supposed. During a drought reptiles become very scarce. One August day when all the small streams had been dried up by a droughty summer a friend and I found in the bed of a dry run a large garter snake evidently in search of water. It was taken to an open field, and while I went after my camera my friend kept it from returning to the shade. It made two or three efforts to escape, but he thrust it back with a stick. On my return within a few minutes I found the snake lying with its mouth open and stark dead. It may have been injured by the rough handling, but I am convinced that its death was caused primarily by thirst and the intense heat of the parched ground.

Among our common snakes none is more interesting than the hog-nose snake, which forms the initial letter of this article. The hog-nose snake is known in different localities as the blowing viper, spread-head, or spreading adder. The body is stout and short, its usual length being something under three feet. The color is a reddish brown above with dark blotches, but some of the species are black. If the hog-nose has gorged itself recently, and is overtaken in its slow and laborious crawling, the curious snake halts, and having disgorged its partly digested food, generally a large toad, moves away at a livelier rate. And if still pursued or touched the chances are that it will throw itself into contortions, at length turning on its back and feigning death with mouth open, tongue protruding and its tail curled into a curious little spiral—for what reason it is difficult to conjecture, unless by playing 'possum it hopes to escape. Many people say that the snake commits suicide by throwing its jaws out of place. The wide extended jaws, however, soon come together and the snake turns over quickly and makes off. When confronted by a dog the hog-nose is at its best. It spreads its anterior ribs, flattens its head as if there were no bones in it, twists its tail into the inevitable spiral, and hisses as viciously as an old goose. Although perfectly harmless and useful, the spreading adder pays dearly for its blustering ways, for many people take it to be the hated copperhead. Its color also aids in the deception.

(To be continued.)

New Boston-New York Electric Automobile Record.

Several days after the Messrs. Babcock's run from Boston to New York (described in our October 31 issue) was completed, the second electric vehicle to make this 244-mile trip arrived in New York. It was the Boston Edison Electric Illuminating Company's Columbia service wagon, which is equipped with solid rubber tires, and is propelled by one of the new Edison storage batteries. The longest run on a single charge was the fifty-three miles from Worcester to Springfield. The journey occupied four days, and the cost for recharging *en route* was stated to be $7.50.

Mr. H. M. Wilson, who ran the machine in this instance, recently made the return trip in it in 48½ hours elapsed time, or 22 hours, 52 minutes actual running time, thus making an average speed of 10.8 miles an hour. This will stand, therefore, as the electric vehicle record between Boston and New York, until faster and more powerful electric autos are constructed with which to beat it.

The Current Supplement.

The current SUPPLEMENT, No. 1454, opens with an illustrated account by Frank C. Perkins of German marine boiler construction. M. Eugène Pettigont presents an interesting and instructive account of analyses and tests of paper. "Fire Appliances at the Exhibition of the German Cities in Dresden" is the title of an article in which appliances are described which will probably be new to many of our readers. Mr. George J. Henry, Jr., recently read a paper before the Pacific Coast Electric Transmission Association in which he discussed tangential water-wheel efficiencies. Mr. Henry has analyzed these efficiencies, not mathematically, but photographically. The paper will be accompanied by very striking instantaneous photographs showing the action of a stream of water on a Pelton bucket. Prof. Raphael Meldola discourses on the relations between scientific research and chemical industry. The biological purification of sewage water is a subject which will be of interest to sanitary engineers. Emile Guarini presents an account of an unusual form of capillary electrometer. "The Faure Type of Accumulators" gives quite a thorough review of the principle of storage battery construction and operation. The usual consular reports, engineering, electrical and trade notes will be found in their accustomed places.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC JAIL-ALARM.—R. F. ADAMS, Birmingham, Ala. The invention relates to jail-alarms specially adapted for indicating, at the warden's room or separate building in which he may reside, tampering with or severing of the jail-window grating by the prisoner in his attempt to escape by breaking or sawing the bars of the window-grating.

Heating and Lighting.

LIGHTING ATTACHMENT FOR GAS-STOVES.—L. E. ADAMS, Galena, Ohio. Pressure of gas varies in the mains and sometimes is so low as not to furnish sufficient gas to keep a lighted stove burning. At times it becomes necessary to leave the room or house for a short period, in which there is a lighted gas-stove. During this period the pressure of gas in the mains may fluctuate and get so low as to allow the jets to flicker out or be blown out by slight draft of air. This invention relights the jets upon return of gas to normal pressure in the mains.

HOT-AIR FURNACE.—T. F. MEINHARDT, Charlottesville, Va. This furnace provides a separate heating-chamber for each room, so the heating chamber can be proportioned to the area of the room. Means are provided whereby the opening and closing of the register in any given room will operate a valve, so that when the register of any room is opened the valve controlling the hot-air pipe leading to such room will be opened and when the register is closed the valve will close the pipe and open communication between the particular chamber and the furnace dome to prevent undue superheating in any particular hot-air chamber or hot-air pipe or furnace.

STOVE.—J. WOOD, Noroton, Conn. The prime feature of this invention is a construction involving an air-jacket surrounding the stove, so that the cold air entering at the bottom may be heated by contact with the walls of the stove and discharged from the top of the object to heat the surrounding air or be carried off to another apartment of the building in which the stove is placed.

OIL-BURNER.—E. B. RAYMOND, Dallas, Texas. In this patent the invention relates to a burner which may be used either with crude or refined oils, and the burner is adapted particularly to be applied to the fire-boxes of stoves. The combustion of the burning gases is complete and no smoke is developed by the burner.

HOT-AIR FURNACE.—F. J. PIOCH, Creston, Iowa. In the present case the invention relates to hot-air furnaces and to analogous heating appliances, the more particular object being to increase the efficiency and controllability of the draft and to produce certain improvements in construction. Both a sinuous and a straight smoke offtake are provided to permit of proper regulation of the furnace.

Of Interest to Farmers.

SICKLE-BAR.—B. F. STUART, Rushville, Mo. In this instance the improvement refers to a sickle-bar for harvesting machines of all classes; and its object is to provide superior means for holding the sickles in place and for allowing them to be separately removed without entirely dissociating the bar and without involving the use of rivets or the like.

Machines and Mechanical Devices.

FELLY COMPRESSING AND BORING MACHINE.—G. A. ENSIGN, Defiance, Ohio. Mr. Ensign's invention has reference to woodworking machinery; and his object is to provide a new and improved felly compressing and boring machine arranged to form oblong spoke-holes in the felly, to prevent checking and splitting thereof, and to allow convenient adjustment for fellies of different sizes.

RIMMING MACHINE.—F. UNCKRICH, Galion, Ohio. The machine embodies a saw for trimming the ends of wheel-rim-sections, so as to cause them to fit properly with respect to each other, and a hammer serving to drive the rims onto the spokes, together with such auxiliary devices as the means for holding the wheel-hub during these operations, for operating the hammer and saw, and the devices for mounting and adjusting the various operative parts.

LIFTING-JACK.—G. STOCKAMP, Hooper, Neb. In this patent the invention refers to an improvement in lifting-jacks, and has for its object the provision of a simple, cheap, and efficient device which may be used for lifting vehicle-axles, whereby the axle-spindles may be oiled. It may be also used for lifting rails, houses, etc., and possesses great lifting power.

Railway Accessories.

NUT-LOCK.—M. J. WALZ, Defiance, Ohio. The object of this invention is to provide a construction for a nut-lock that is simple, practical, very effective in operation, and adapted for general use to reliably hold a nut on a bolt for securing the bolt in place and preventing the loosening of the nut when tightened thereon. The invention is well adapted for application upon a bolt for clamping two fish-plates upon a track-rail.

STATION-INDICATOR.—P. P. I. FYFE, Concord, N. C. This invention is an improvement on two former patents granted to Mr. Fyfe. It provides a construction whereby the names of stations or streets, with or without advertisements, may be displayed at the car ends, when the time for displaying arrives, and provides means operated so that one roller will wind up material while the next will be turned in direction to drop its curtain and whereby the operating means will travel from one pair of rollers to the other until all in a series have been operated on. Mr. Fyfe has invented another station-indicator, which displays in street or railroad cars the names of streets or stations, with or without advertisements, upon tapes carried by spring-controlled reels, with means for causing one tape to be rolled up upon its reel simultaneously with the next tape being unwound to expose data and held in display position until released.

CAR-STAKE POCKET.—J. F. MCKECHNIE, Eleele, Hawaii. The object of this invention is to provide novel details of construction for a car-stake pocket which will hold the stake in a vertical position, prevent rattling of the stake, greatly strengthen the side walls of the pocket, and prevent detachment of the stake accidentally, but permit its convenient removal from the pocket.

FLUID-PRESSURE BRAKE APPLIANCE.—A. G. TURLAY, Clinton, Ill. In this case the object is to provide a safety appliance for connection with the train-pipe in the cab of a locomotive to cause automatic application of the brakes whenever the train-line pressure falls below a predetermined pressure, which is caused by stoppage of the air-pump or gradual air leakage not sufficient to apply the brakes or move the triple valve and allow air to pass from the auxiliary reservoir to the brake-cylinder and out through a leakage-groove without applying the brake.

NUT AND BOLT LOCK.—H. E. OWEN and A. J. SHAW, Spokane, Wash. The inventors by this improvement are able to use a round bolt to fit round holes for bolts, forming the bolt with the flattened threaded portion to fit the flattened opening in the locking-plate, thus furnishing a nut-and-bolt-locking device applicable with great economy to structural work, in bridges or other structures. This construction prevents accidental turning of the nut or of the bolt independent of the nut in use of the invention, on rail-joints, etc.

Miscellaneous.

DECOY.—G. E. LOEBLE, New York, N. Y. Mr. Loeble's invention relates to improvements in decoys for wild birds or fowls, especially aquatic birds or fowls, an object being to provide a decoy so arranged as to be operated from a distance to rise and fall and to move the wings, thus giving a life-like appearance and immediately attracting the birds or fowls.

SCISSORS-HOLDER.—A. E. MOORE, Winnipeg, Canada. The prime object is to provide means for holding the scissors within convenient reach of the user and by which the scissors may be held securely and readily engaged with or disengaged from the holder. To this end the invention comprises a body, gripping-fingers carried thereby and serving to hold the scissors, and a device at the rear of the body for attaching it to the clothing of the wearer.

SECTION-LINER.—R. KASTMANN, New York, N. Y. This is an invention which relates to an instrument for facilitating the drawing of parallel lines. Such lines are very commonly employed in the art of drafting to indicate sections, and it is to this work that the invention is especially adapted, although it may be employed in the various other branches of drawing, if so desired.

STIRRUP AND CONNECTIONS THEREFOR.—W. J. MAY, Leonard, Texas. This invention refers to novel features of construction for a stirrup and connections therefor which suspend the stirrup and an attached fender device at right angles to each other and dispose the stirrup in position for engagement by the foot of a rider without twisting the connection of the pendent stirrup-leather with the saddle or disarranging the fender from normal adjustment.

DEVELOPING-TRAY.—W. H. C. DUDLEY, JR., Americus, Ga. Mr. Dudley's invention refers to improvements in trays for developing photographic films, an object being to furnish a developing-tray of simple and inexpensive construction particularly adapted for outdoor or daylight developing and with which the work may be quickly and easily done with a comparatively small amount of solution.

CHAIR.—O. C. DORNEY, Allentown, Pa. The object of the inventor is to provide a chair of simple construction, having no parts liable to get out of order or break and so arranged that the seat and back may be easily adjusted as desired. The invention has reference to improvements in chairs particularly adapted for use in schools, theaters, public halls, and the like.

HAT-SHAPING DIE.—M. A. CUMING, New York, N. Y. In the present patent the invention of Mr. Cuming has reference to hat-making machinery, and more particularly to an improved hat-shaping die for forming bell-crowned hats—that is, hats in which the crown diminishes in diameter from the tip to the base.

CONVERTIBLE CHAIR.—W. D. RUSSELL and F. N. RUSSELL, Streator, Ill. This chair relates to improvements in convertible chairs, the object being to provide a device of this

(Continued on page 356)

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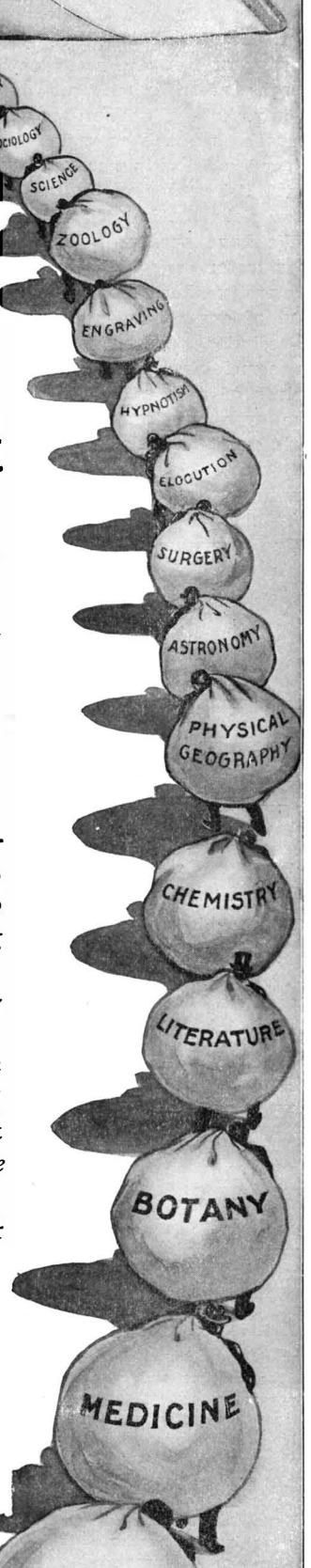

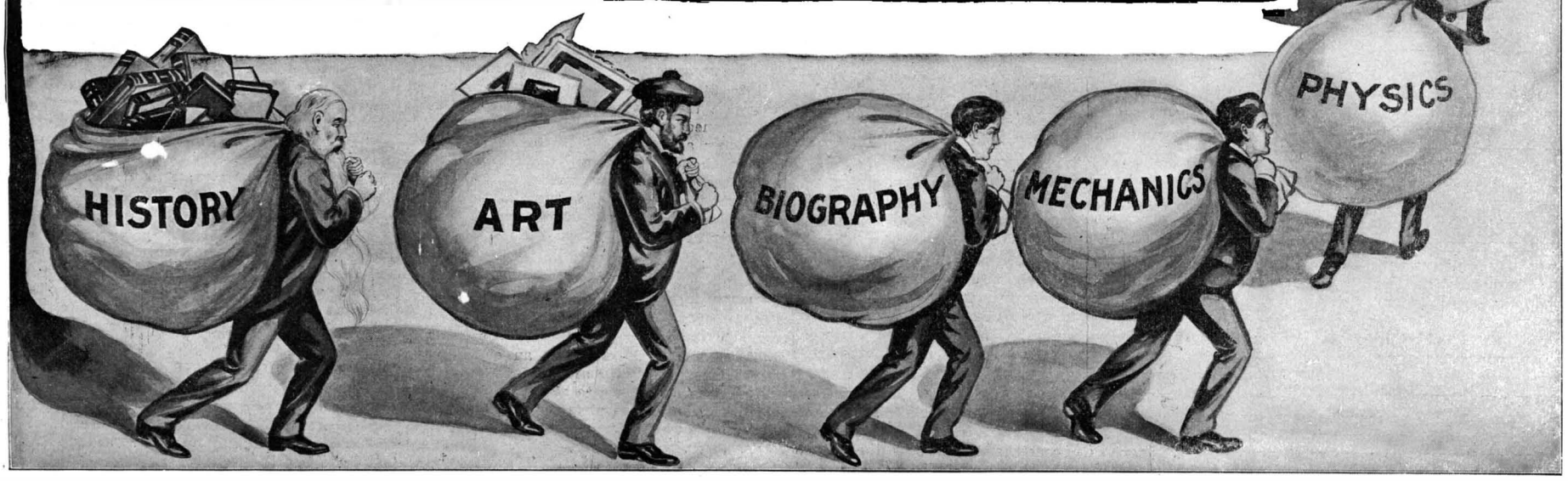

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character that may be easily arranged to form a reclining-chair, a rocking-chair, a stationary high chair and jumper, or a bed and when not in use may be compactly folded.

TOY.—F. R. DAVIS, Washington, D. C. This invention is an improvement in toys, being in the nature of a light-box designed to carry a candle or other illuminant to shine through fancy patterns of mica, colored tissue-paper, or other transparent or translucent material. As the toy is pulled along the ground its pattern-disks will be automatically revolved, displaying figures on the disks and increasing the attractiveness of the box.

DESIGN FOR A BROOCH, BUTTON, OR BUCKLE PLATE OR LIKE ARTICLE OF MANUFACTURE.—C. M. WENDELSTEIN, Attleboro, Mass. This is an ornamental design for a brooch, button, or buckle plate, or like article of manufacture in which the figure represents an irregular shaped yet graceful border pointed with leaf clusters surrounding a flat surface on which is depicted the full-faced head and neck of a young woman.

AXLE OR SHAFT MARKER.—O. SOVELIUS, Hancock, Mich. The apparatus provides means for marking axles or shafts so as to accurately lay off thereon the points and lines for the proper position and direction of the drill or planing machine in boring, planing and milling. The marker comprises a saddle which sits upon the axle to be marked. A center punch is mounted upon the saddle, and on release of a catch is operated by a spring, to strike the axle and make a mark. Two spirit levels are provided. One, which is stationary, determines the vertical position of the punch and the other, which is mounted in a rotary graduated plate, may be used to measure off any angle from the vertical desired.

STICKY FLY-PAPER.—O. A. JONES, Union City, Mich. The particular object of this invention is to remedy many defects incident to fly-paper now in use, of which the oozing out of the adhesive substance over the edges of the base-sheet upon surrounding objects, is an example. Another object is to so form the surface of the paper that it may be readily and easily separated without tearing or destroying it, yet will always retain the adhesive substance upon the border of the base-sheet.

FLASK-CLAMP.—I. R. BROWN and L. A. BROWN, Ebensburg, Pa. In carrying out this invention the object in view is the provision of a clamp for molding-flasks of simple construction that may be quickly adjusted to lock the flask members together. The clamp may be made of different lengths, and each clamp, as it consists of two sliding members, has a considerable range of adjustment for different sizes or depths of flasks.

WATCH-HOLDER.—R. K. HOHMANN and A. ROSENFELD, San Diego, Cal. In this patent the invention relates to improvements in holders or pockets for watches, particularly women's watches, an object being to provide a holder that may be readily attached to a dress-waist, belt, or any part of a garment and as easily removed, the device also having means for preventing accidental dislodgment of the watch.

MARKING INSTRUMENT.—F. MOEHLE, Mason City, Iowa. The device comprises a base with a central pin and a number of grooves of various forms therein. On the pin an arm is mounted to slide and to swing, the arm having a pin arranged to run in any of the grooves. By adjusting this pin in the desired groove the arm may be swung over the base and various ovals or circles described. Other measurements may be made by the arm for describing squares and other like figures.

CHATELAINE-PIN.—NETTIE F. VALENTINE, Brook Haven, N. Y. In this instance the improvement relates to a pin useful in many respects, but especially designed for application to women's waist or "chatelaine" bags, in which connection it serves to prevent the bag from swinging idly about as the wearer walks and also prevents the bag from being torn from its place.

CURRENCY-HOLDER.—F. E. WALKER, Bedford, Iowa. The purpose in this case is to provide a holder in which bills may be held in separate bunches of equal amounts and to so number the partition strips that the total amount of cash may be ascertained at a glance without counting, thus facilitating the making up of the cash account at the end of a banking day and also facilitating the withdrawing of notes of a desired amount.

ARTIFICIAL DENTURE.—G. J. DAVISON, Richmond, Va. The present invention is in the nature of an improvement in artificial teeth, and especially in the means for securing the porcelain facing. Important features of the invention consist in not limiting the improvement to any special kind of tooth, and to the ability of the inventor to apply rubber-plate teeth to a bridge without vulcanizing them on.

LUBRICATOR.—C. L. HOFMANN, Cincinnati, Ohio. In the present patent the invention is an improvement in lubricators, and especially in that class of such devices for application to pulleys and the like wherein the pulley revolves on a bearing or shaft and the lubricator revolves with the pulley.

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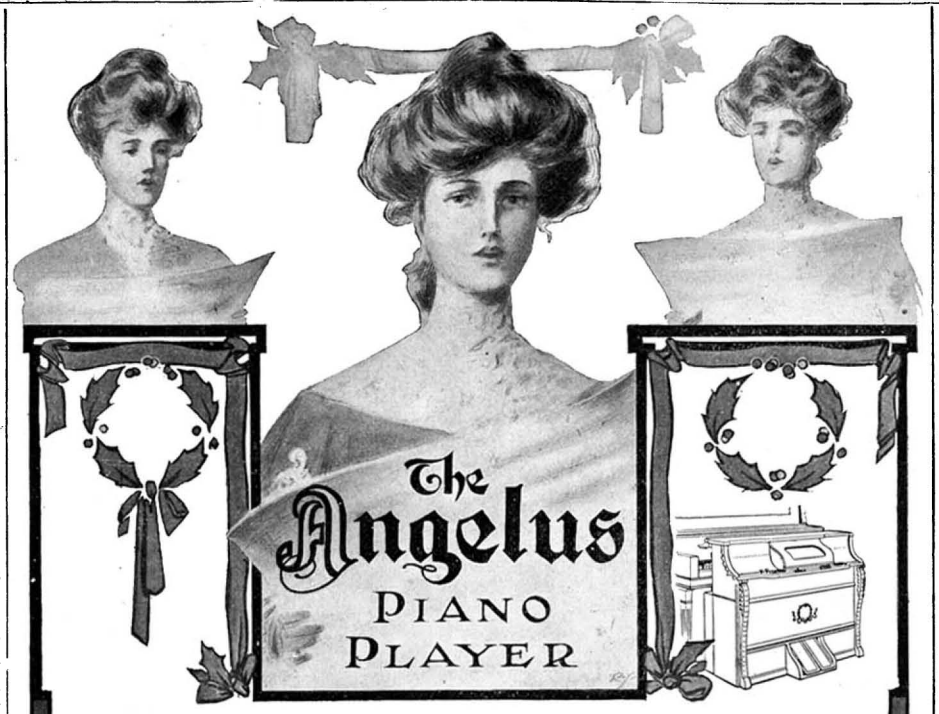

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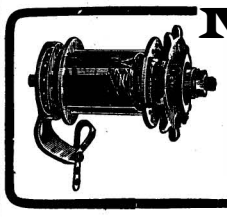

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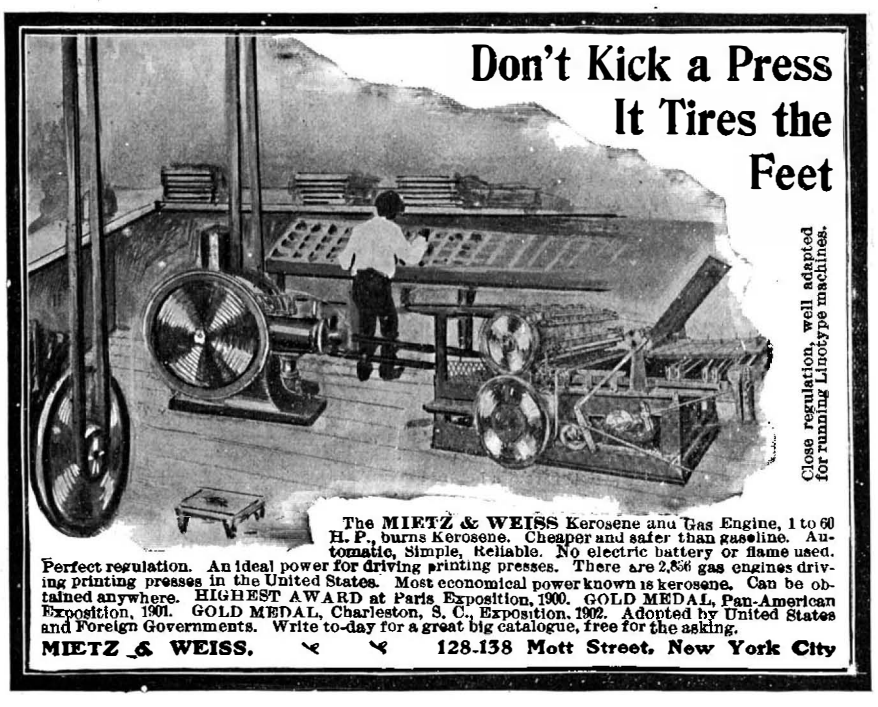

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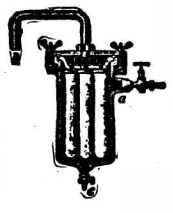

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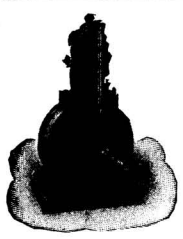

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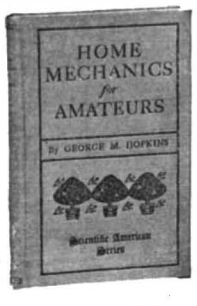

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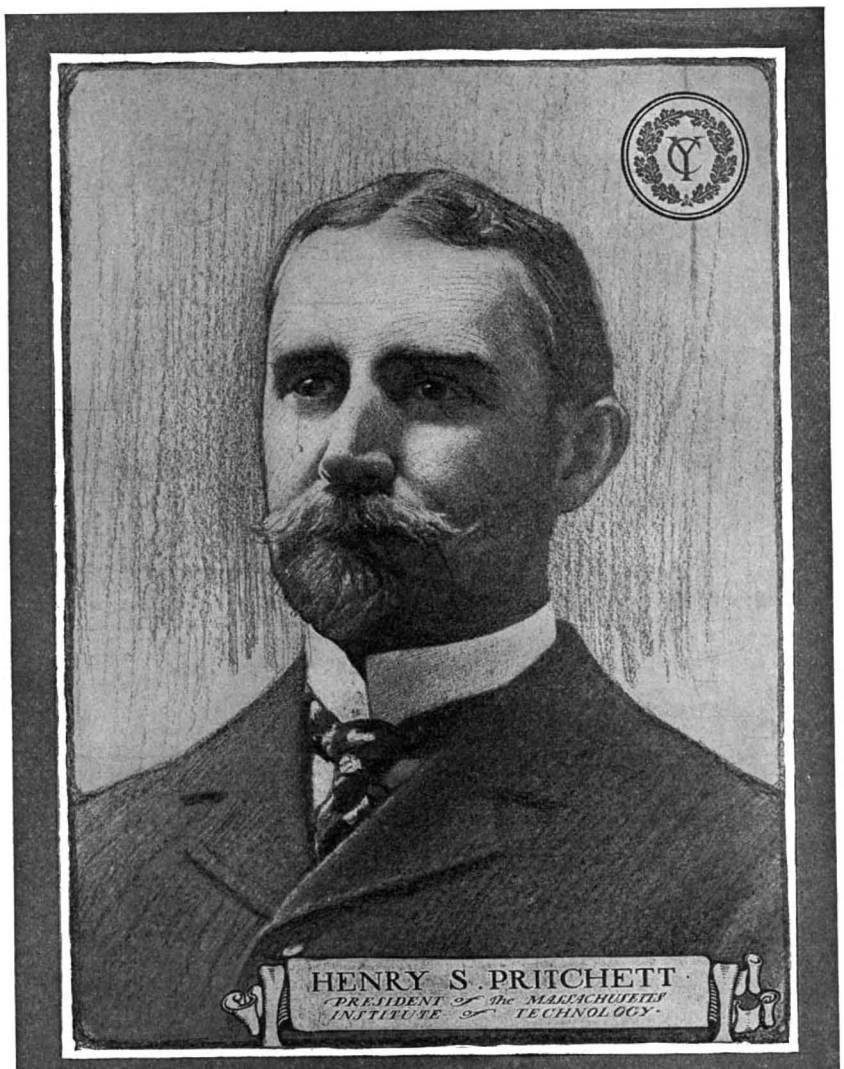
(9225) E. T. R. says: 1. What would you figure the indicated and actual horse power of 3½ and 6 by 5 compound marine engine, running at 500 revolutions per minute on 150, 200, 250, and 400 pounds pressure, cut-off at 5-6 stroke? A. We estimate the indicated power of your compound engine at 200 pounds initial pressure and 500 revolutions per minute, at 40 horse power. At other initial pressure, in proportion to the pressure. 2. Can you give me a formula for finding the minimum thickness of cylinder walls for any pressure? A. The thickness of small high-pressure walls of cylinders should be 1-7 their diameter, and for low-pressure cylinder walls 1-10 their diameter. 3. If this engine were put into a boat 40 feet long, what would be proper size of screw to propel it at maximum speed, and what style of boat would give best results in that line? A. The engine and 40-foot boat should have a propeller 30-inch diameter, 56-inch pitch. The boat should be 7½ feet wide, with fine lines, and should draw 36 inches in depth at the stern. 4. Would it be practicable to put two engines into same boat and use two screws? What would be the maximum speed? A. We certainly do not advise the use of two engines and screws in a small boat. You should make a speed of 10 miles per hour. 5. What size of water-tube boiler (smallest possible) would be required to run engines at pressure mentioned in query 1, that is, what grate area and heating surfaces? A. You will need a boiler with 200 square feet heating surface and grate area 16 square feet.

(9226) E. F. P. says: Am I right in my opinion that the elementary substance selenium is, when lighted, a conductor of electricity, and when not, non-conductor? I mean that in darkness it is a non-conductor. Would you kindly inform me where I can obtain it, in what form and at what price (approx.) for ca. 1″ and 0.05′ thick? A. You can find the fullest description yet published of the properties and preparation of selenium in the SCIENTIFIC AMERICAN SUPPLEMENT No. 1430, price 10 cents. Selenium is a non-metallic element, a non-conductor of electricity, but which has its resistance reduced from five to twenty times in the sunlight. The paper referred to describes experiments and apparatus for exhibiting its peculiar properties. Any dealer in chemicals can supply it.

(9227) F. H. S. writes: 1. I inclose herewith what I take to be a natural curiosity. The little sheet that so resembles a piece of mechanically made wood pulp is a portion of a strip 13 inches long, found in a fissure or rift in a spruce tree. The constant grind of the two sections of tree as they swayed in the wind may have made the formation, or product of worms and the admixture of water in the way of rain, and the same process of grinding may have resulted in this peculiar production. What do you think? A. The piece of paper made by macerating spruce fiber by the rubbing together of the two parts of the split trunk is very interesting. There would not appear to be any reason why it should not be formed under such conditions. 2. One day I was standing on the shore of the St. John River, and noticed an unusually fat black cricket, seemingly determined on suicide. It sprang into the water, and I fished it out with my cane; it skipped in again and again. Seeing its determination to remain, I watched to see what it would further do. The cricket produced what, as a boy, we knew as a "hair snake," the peculiar monster common in puddles. Have you ever heard of this before? If so, please explain. A. The voiding of a Gordius, or hair snake, by a cricket is also an occurrence which is probably not often witnessed except when the insect is in captivity for observation. This little worm, erroneously thought to be a transformed horsehair, spends a part of its life in locusts and other insects, and when it is prepared for the change, it merges into the outer world. A full account of its transformations may be found in Packard's Zoology, under the genus Gordius, and probably also in books of a similar character.



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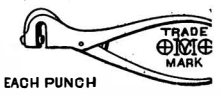

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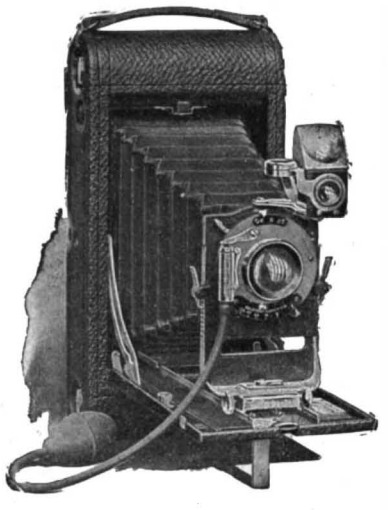

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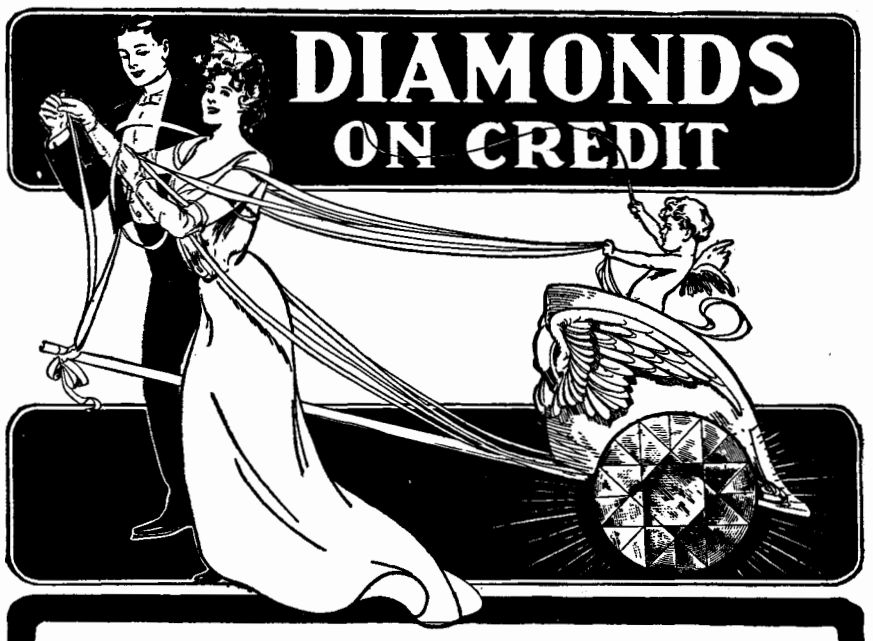

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THE ENCYCLOPEDIA AMERICANA. A General Dictionary of the Arts and Sciences, Literature, History, Biography, etc., of the world, in sixteen volumes. Editor-in-Chief, Frederick Converse Beach. New York and Chicago: The Americana Company. Vols. III. and IV.

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ELEMENTS OF ELECTROMAGNETIC THEORY. By S. J. Barnett, Ph.D. New York: The Macmillan Company. 1903. 8vo. Pp. 480. Price $3.

The author says in his preface that he has tried to present in systematic and definite form a simple, rigorous, thoroughly modern introduction to the fundamental principles of electromagnetic theory, together with some of the simpler of the more interesting and important non-technical applications. The work makes no pretense to completeness, but is written for the serious student of physics, who will make liberal use of more detailed treatises of handbooks and of journals as occasion demands. The subject is largely taken up from a mathematical standpoint.

SMALL YACHT CONSTRUCTION AND RIGGING. By Linton Hope. New York: Forest and Stream Publishing Company. 1903. 8vo. Pp. 177. Price $3.

The author deals with this subject from the keel up, and the detail drawings are most admirable. The book gives precisely the information that inexperienced yacht-builders are sure to desire to know. It is a book that we can commend to all yachtsmen or would-be yachtsmen. There are a number of large-scale plans in a pocket at the back of the book.

HOMOPHONIC CONVERSATIONS IN ENGLISH, GERMAN, FRENCH, AND ITALIAN. Being the Natural Aid to the Memory in Learning Those Languages. By C. B. and C. V. Waite. Chicago: C. V. Waite & Co. N. D. 16mo. Pp. 137. Price $1.

The distinguishing feature of this work is that the principal words of nearly every sentence have a like sound and a like meaning in the four languages, or at least in three of them. It is manifest that this arrangement will be of great service in enabling the learner to remember, not only the words themselves, but the construction of the sentences as well. It is simply applying the principle of association to aid us in learning the languages. Some of the methods therein taught are extensively practised in every-day life, but this work differs from those in that it contains not a single artificial sentence, hence it is called a natural aid to the memory.

THE AMERICAN STEEL WORKER. By E. R. Markham. New York: The Derry Collard Company. 1903. 12mo. Pp. 343. Price $2.50.

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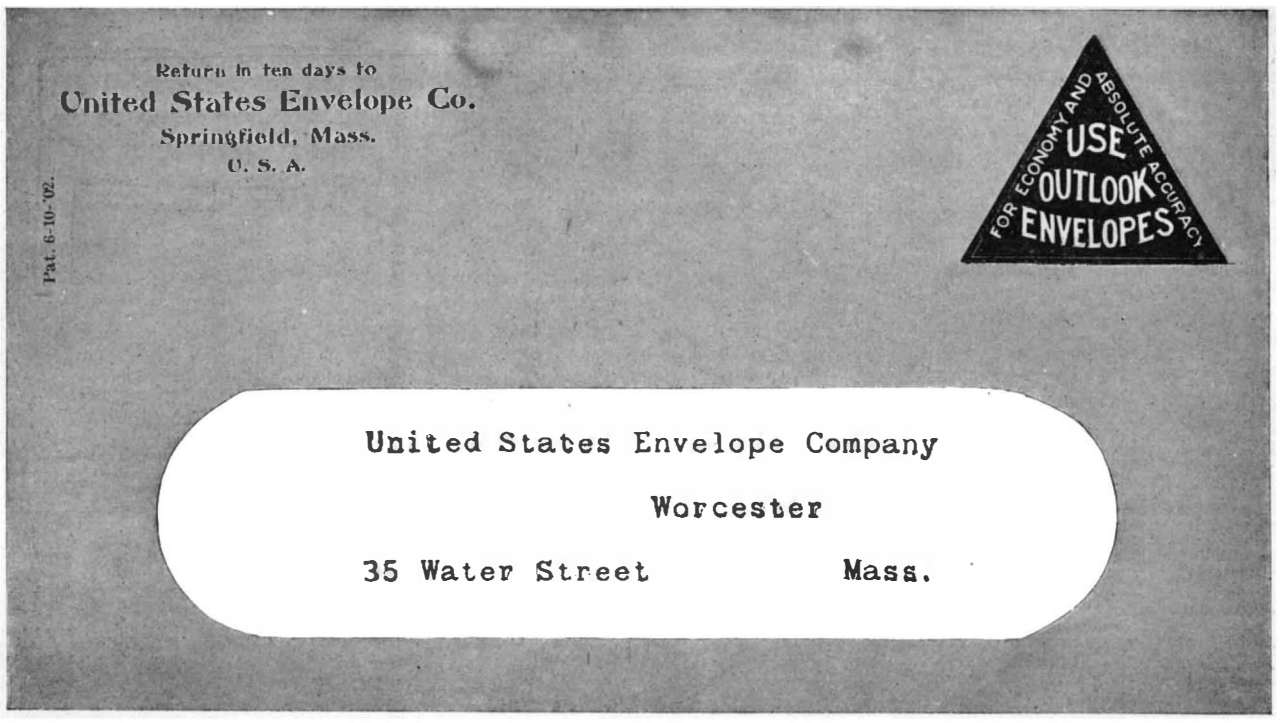

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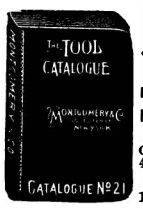

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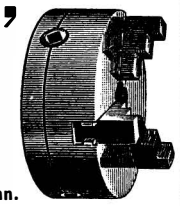

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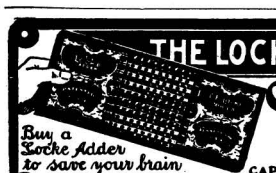

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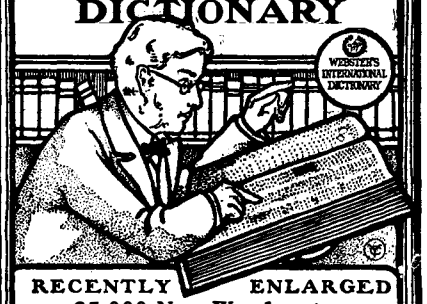

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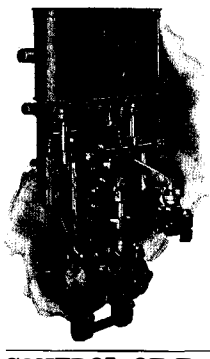

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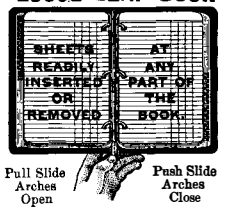

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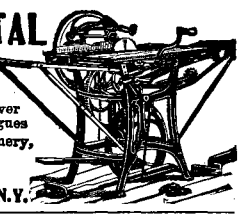

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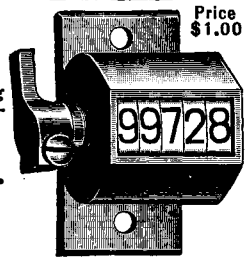

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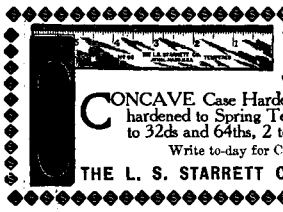

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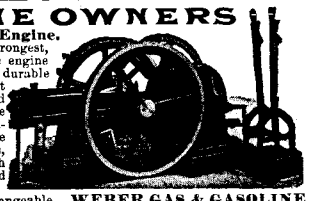

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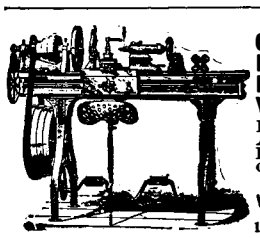

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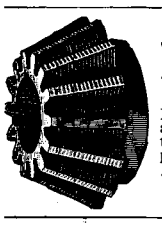

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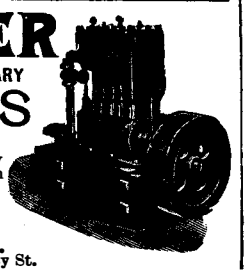

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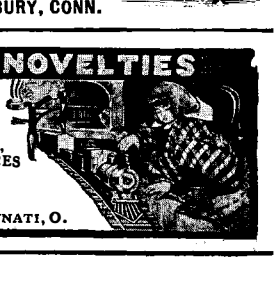

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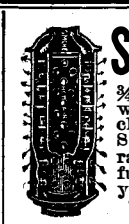

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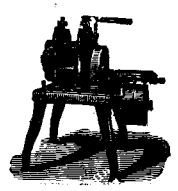

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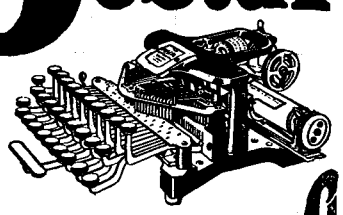

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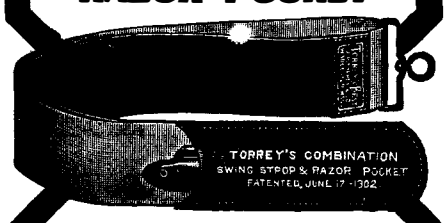

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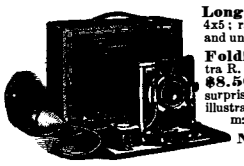

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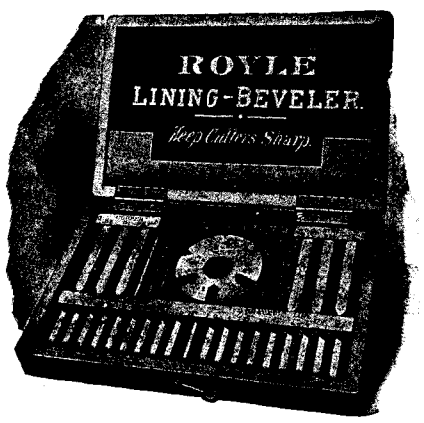

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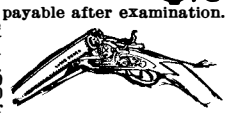

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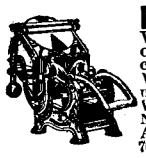

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PROPOSALS WILL BE RECEIVED AT THE Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, November 24, 1903, and publicly opened immediately thereafter, to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of hawse pipes, warping chocks, electric blowers and exhausters, generating sets, arc lamps, conduit, wire, electrical supplies, bolts and nuts, copper rivets, washers, corn brooms, paint brushes, feather dusters, oakum, steel cable, window glass, coaling baskets, steel wire and copper nails, miscellaneous hardware and hand tools, files, machinists' sets, lamp wick, pump and rigging leather, ash, Oregon pine, boards and piles, Spanish and Port Orford cedar, mahogany, sugar pine, cherry, walnut, oak, teak, poplar, spruce, hickory, laurel, locust, redwood, fir, bar iron, pig lead, galvanized sheet steel, bar steel, gum and flax packing, garden hose, paints, white and red lead, linseed, cylinder and lard oil, alcohol, turpentine, damar, asphaltum and paraffin varnish, bronzing liquid, pitch, tar, nitric and sulphuric acids, borax, pipe fittings, gauge glasses, brass and iron pipe, valves, pepper, cocoa, mustard, beans, salt beef, salt pork, raisins, dumping tubs, diving apparatus, blank books, pencils, pens, ink, typewriter paper, toilet paper, miscellaneous stationery, candles, laundry, castile, and salt-water soap, sapolio, and cotton waste. Blank proposals will be furnished upon application to the Navy Pay Offices, San Francisco, Cal., and Seattle, Wash. H. T. B. HARRIS, Paymaster General, U. S. N. 10-21-03

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A wonderful new book entitled, "The Secret of Power," has just been issued, at an expense of over $5,000, by one of the leading colleges of the City of New York. This book is from the pen of the ablest specialists of modern times. The authors gave away the copyright on condition that 10,000 copies should be distributed to the public free of charge. The Columbia Scientific Academy is now complying with this contract, and until the edition of 10,000 volumes is exhausted you can get a copy of this book absolutely free. The book is profusely illustrated with the most expensive half-tone engravings. It is full of wonderful secrets and startling surprises, and thoroughly explains the real source of the power of personal influence. It fully and completely reveals the fundamental principles of success and influence in every walk of life. The hidden mysteries of personal magnetism, will-power and scientific character reading are explained in an intensely interesting manner. Two secret methods of personal influence are described, which positively enable any intelligent person to exercise a marvellous influence and control over any one whom he may wish. These methods are entirely new and have never before been made public. A reporter has tried them personally and can vouch for their wonderful power.

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Not long ago John D. Rockefeller, the richest man in America, said, in talking to a Sunday school class, that he attributed his success in life largely to his ability to influence others. Lincoln, Lee, Napoleon and Alexander the Great all won fame and renown by their wonderful powers of personal influence. Jay Gould piled up millions by this same power. J. P. Morgan organized the billion dollar steel trust and enriched himself by millions simply by his marvellous ability to influence others. There are to-day thousands of men with the brains and education of Mr. Morgan who are practically paupers. They have the ability to organize a trust, but they have not sufficient power of personal influence. Personal influence, will power, stamina—call it what you will—has from the creation of man been the subtle force that has brought wealth, fame and renown to those who are fortunate enough to possess it. This strange, mysterious influence is inherent in every human being. By the late methods explained by the New York specialist in human culture any intelligent person can develop a wonderfully magnetic personality, and learn how to read the character, secrets and lives of others in a few days' study at his own home. You can use this marvellous power without the knowledge of your most intimate friends and associates. You can use it to obtain lucrative employment, to secure an advance in salary, to win the friendship and influence of others, to obtain a greater share of happiness from life. You can be respected, honored and become a leader in your community.

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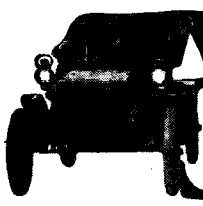

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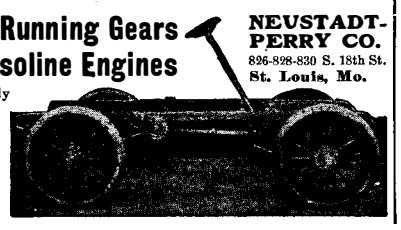

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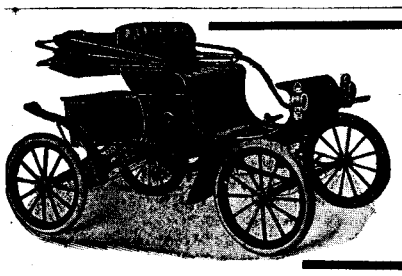

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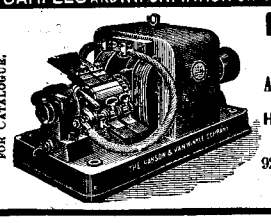

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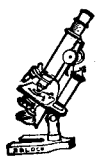

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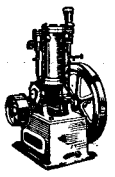

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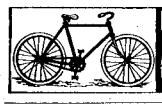

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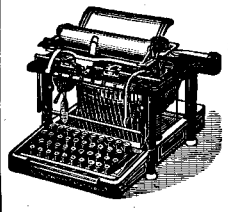

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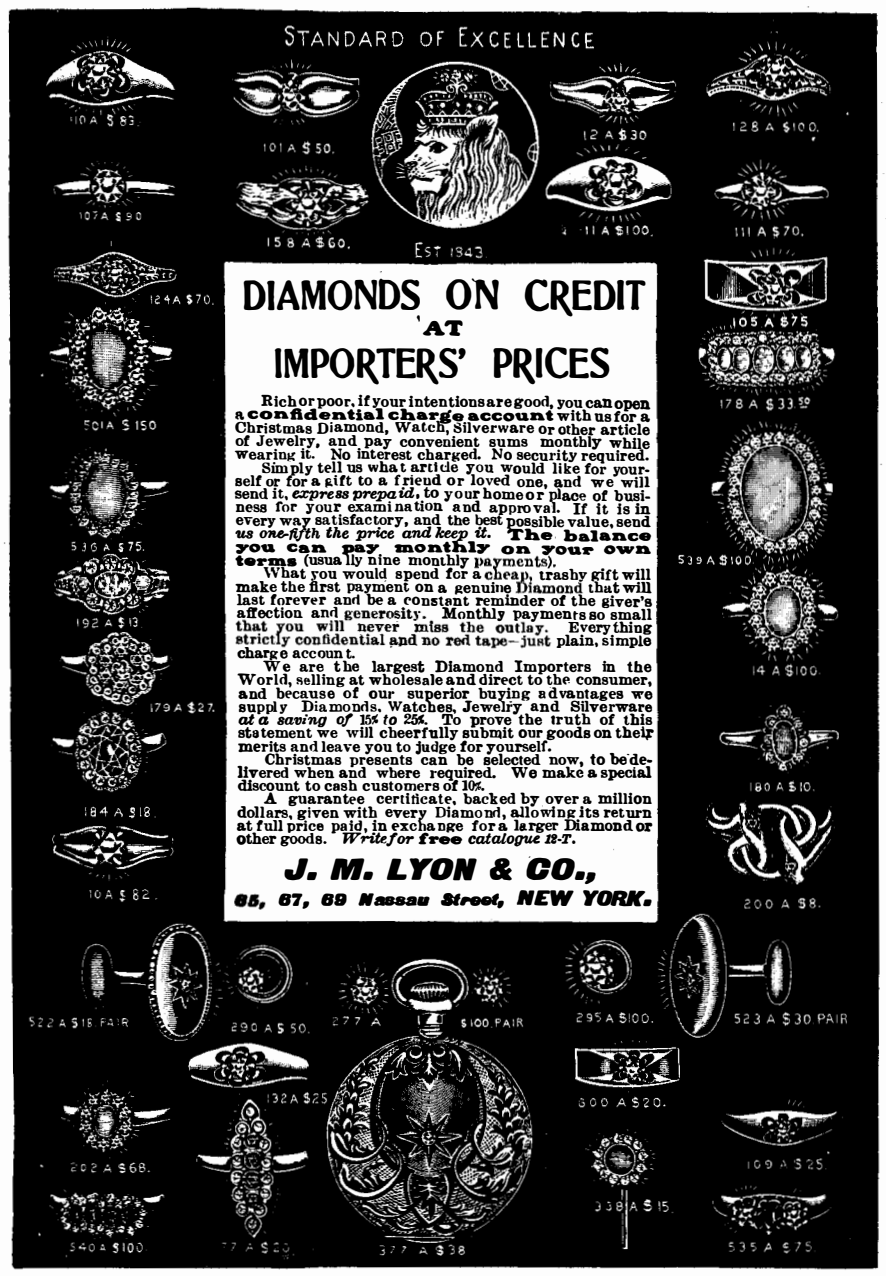

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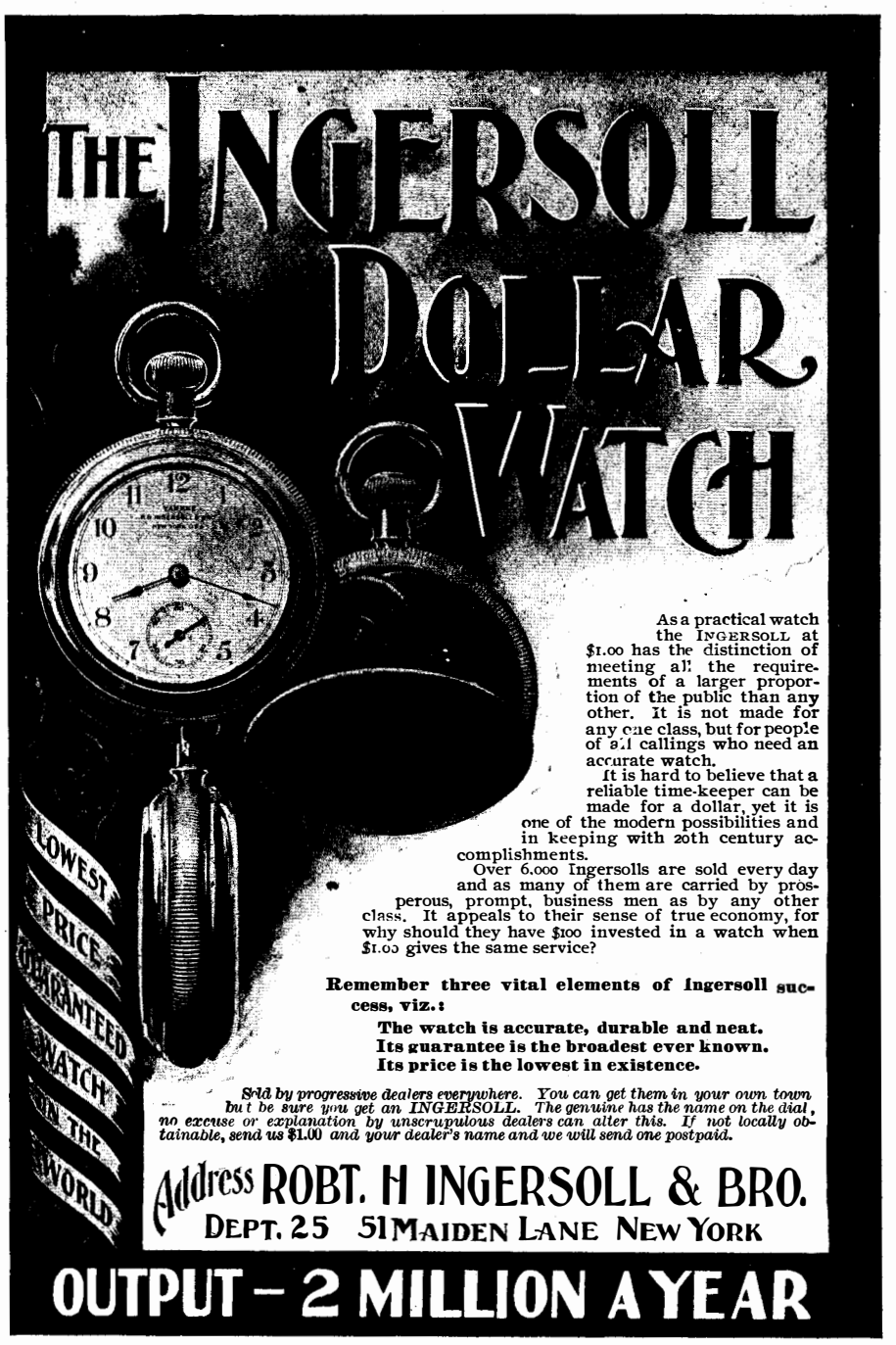

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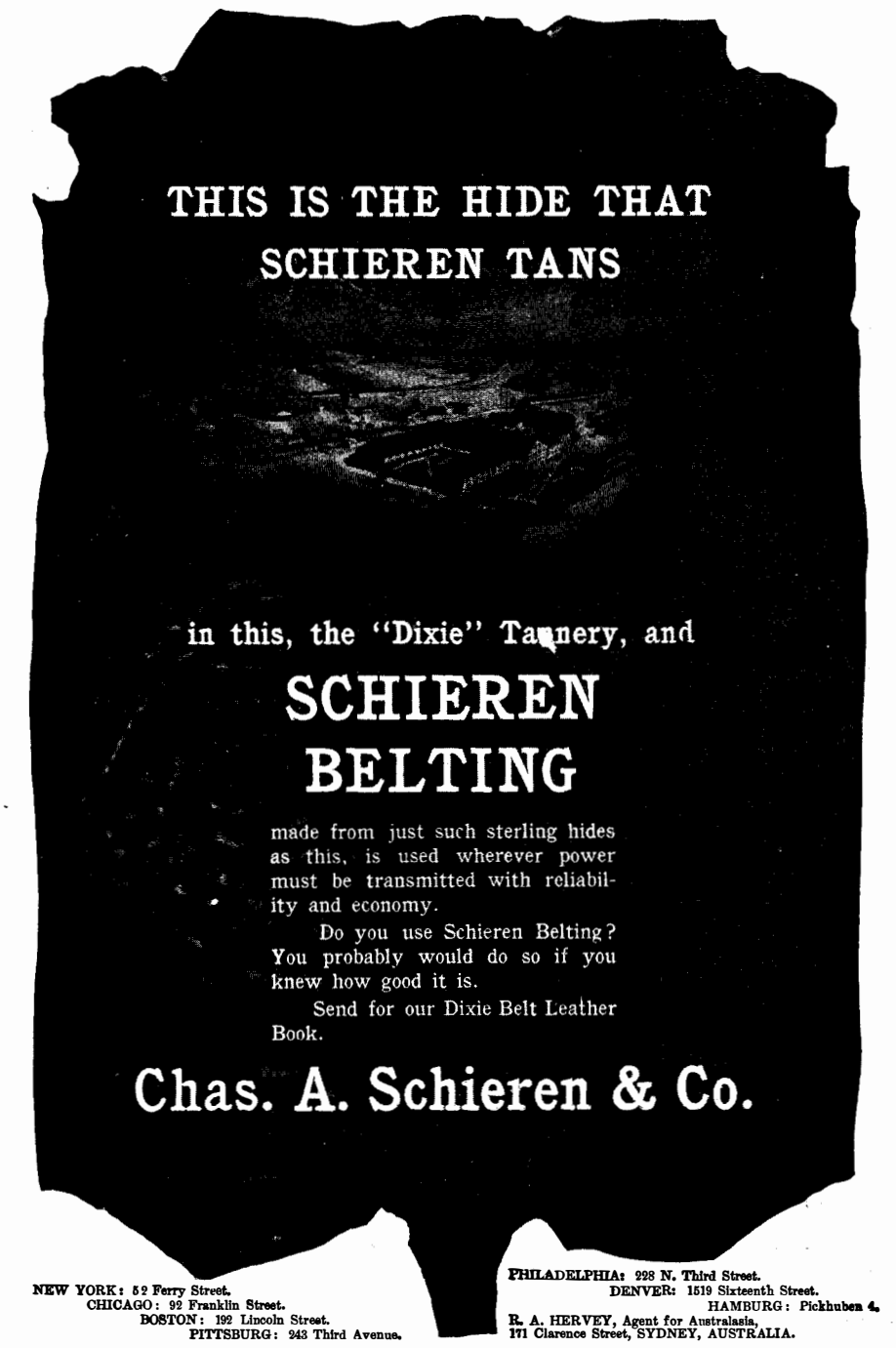
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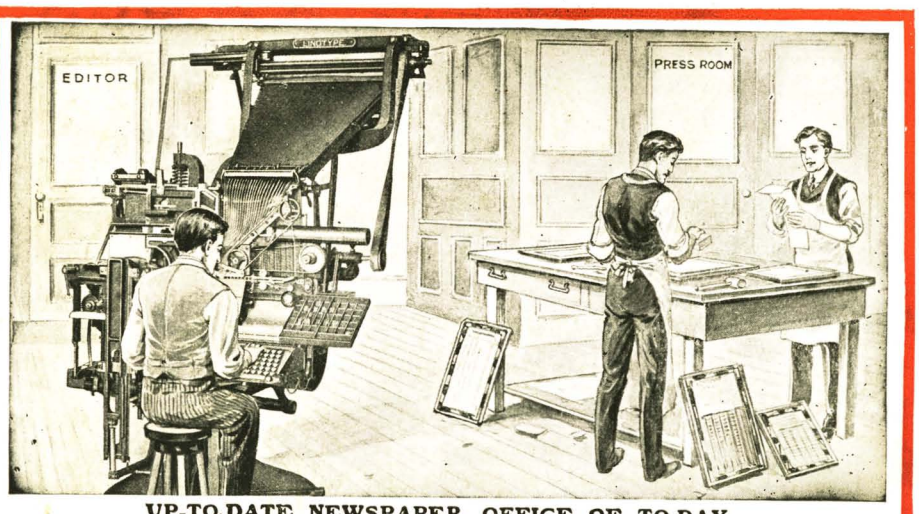

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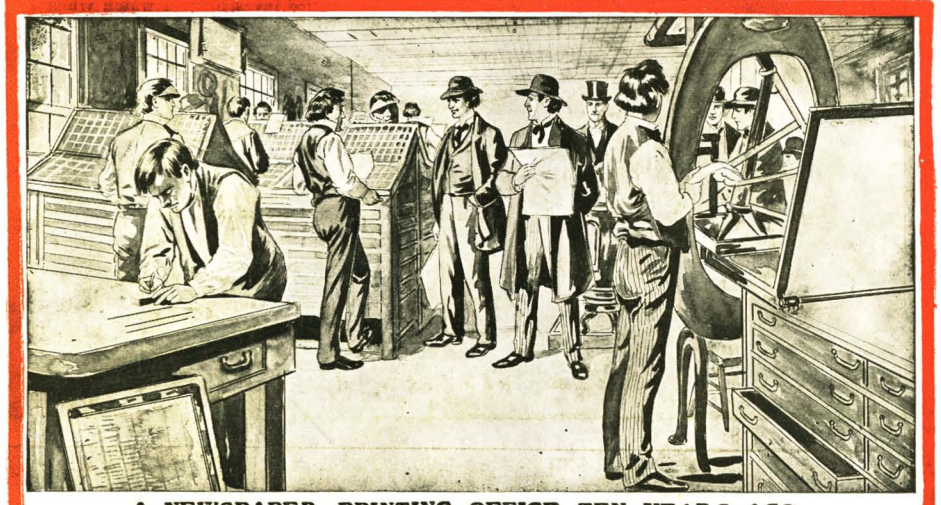

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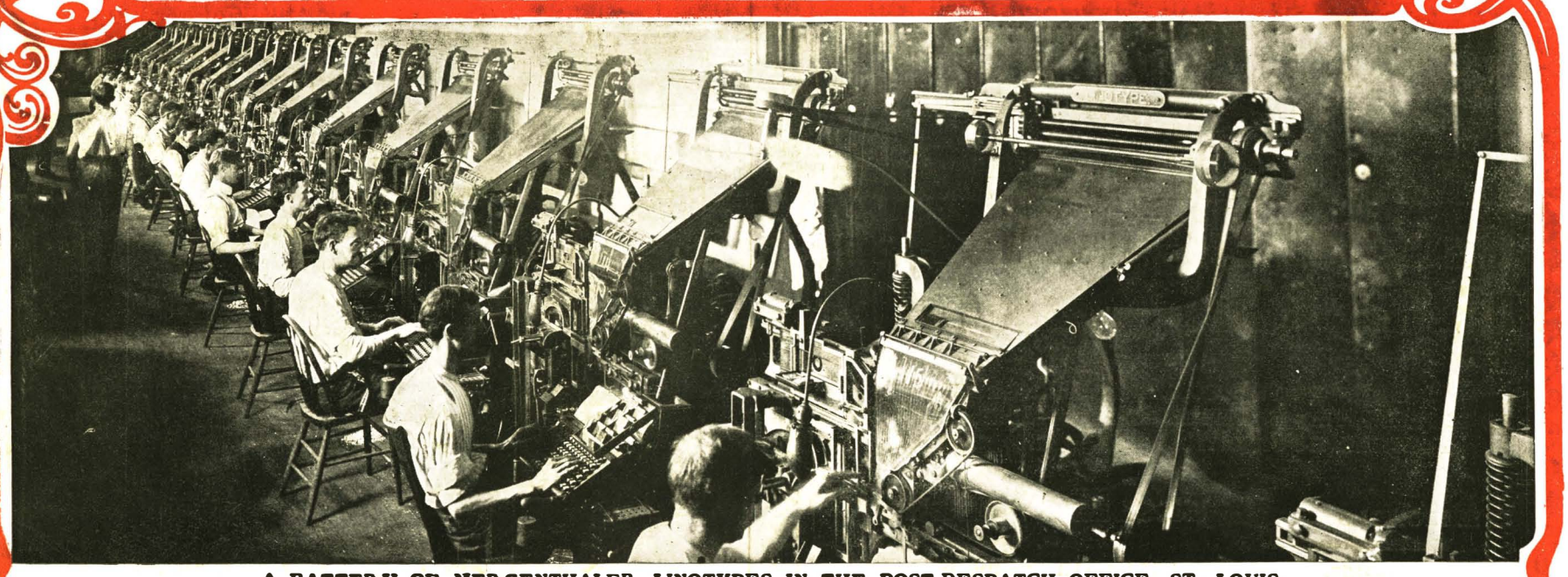
PHILIP T. DODGE, President — **Tribune Building** — **NEW YORK CITY**



A BATTERY OF MERGENTHALER LINOTYPES IN THE POST-DESPATCH OFFICE, ST. LOUIS.

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